Crusader®

OWNER'S OPERATION

and

MAINTENANCE MANUAL

A Division of PLEASURECRAFT ENGINE GROUP

This Page

Was Intentionally

Left Blank

Welcome to the growing family of Crusader Marine Engines owners. We are delighted you have chosen Crusader power for your boat and wish you many years of enjoyment.

When you chose Crusader, you selected the utmost in premium power for your boating application. Crusader is the world's largest manufacturer of gasoline marine inboards, and the clear-cut leader in cutting edge technology. Over the years, Pleasurecraft Engine Group, through Crusader and PCM, has introduced many breakthrough innovations that quickly became industry standards. The pyramidal exhaust system, light-weight transmissions, computerized engine control, micro adjustable all stainless steel mounts, and the Fuel Control Cell (FCC) are all Pleasurecraft innovations. No matter which Crusader model you purchased, you can be sure it is equipped with the latest in modern technology for added performance and durability.

READ THIS MANUAL THOROUGHLY

Before starting your engine(s), READ THIS MANUAL CAREFULLY AND COMPLETELY. If you do not understand any portion of the manual, contact your Dealer for clarification or assistance. Ask your Dealer for a demonstration of actual starting and operating procedures.

The descriptions and specifications contained in this manual were in effect at the time of printing. Crusader Marine Engines' policy of continued improvement reserves the right to change specifications or design without notice and without obligation.

This manual will cover the following year of manufacture Crusader engines:

Year	Model
2009	**5.7L Carburetor**

Part Number - L510019-09 Printed 01/09

TABLE OF CONTENTS

1 - SERVICE AND WARRANTY 4-17
Safety Information 4
Replacement Parts 4
Safety Warnings 4
Crusader Marine Engines' Commitment to You 5
Owner Warranty Registration (Warranty Registration Card is located at the back of this manual) 5
Engine Operation and Care 6
Maintenance Records 6
Local Repair Service 6
Service Away From Home 6
Replacement Parts Inquiries 7
Replacement Service Parts 7
Applicable Limited Warranty 7
Crusader Marine Engines Two-Year Limited Warranty
(For Engines Sold and Used in the United States and Canada) 8
Items Not Covered Under the Limited Warranty 10
Things You Should Know About The Warranty 11
Marine Transmissions 12
Resolving a Service Problem 13
Crusader Master Distributors 14
Dealer's Responsibilities 15
Transferable Warranty 16
Direct Sale By Owner 16
Notes 17
2 - BOATING RESPONSIBILITY 18-20
Carbon Monoxide Hazard 18
Safe Boating Suggestions 19
Water Wisdom 19
Operation and Maintenance 19
Rules of the Road 20
3 - ENGINE IDENTIFICATION 21-22
Engine Identification 21
Owner Identification and Registration Information 21
Engine Model Identification / Advisory 22
4 - OPERATING INSTRUCTIONS 23-27
Instrumentation 23
Engine Alarm System 24
Remote Controls 24
Starting Engine 25-26
Shifting Transmission 26
Stopping Engine 27
Freezing Temperature Operation 27
Operation in High Debris Areas 27

TABLE OF CONTENTS

5 - CONDITIONS AFFECTING OPERATION 28
Trim and Weight Distribution 28
Boat Bottom 28
Propeller Selection 28
6 - ENGINE BREAK-IN PERIOD 29
7 - 25-HOUR ENGINE INSPECTION 30
8 - FUEL REQUIREMENTS 31-32
Gasoline Requirements 31
Gasoline Containing Alcohol 31
Piston Damage Due To Detonation and/or Pre-Ignition 32
9 - OIL REQUIREMENTS 33
Engine Oil Recommendations 33
Transmission and “V”-Drive Oil Requirements 33
10 - ENGINE MAINTENANCE 34-54
Engine Maintenance 34
Checking Fluid Levels 34-35
Lubrication 36
Electrical System Circuit Breaker 37
Electrical System Fuse 37
Ignition Fuse 37
Electrical System Wiring and Connectors 37
Battery 38
Fresh Water Cooling System Sacrificial Zinc Anode 38
Checking Coolant Level 39
Flushing Cooling System - Sea-Water Section 39
Testing Coolant For Alkalinity 40
Draining Fresh-Water Cooling System 40
Filling Fresh-Water Cooling System 41
Cleaning Sea-Water Section of Heat Exchanger (Fresh-Water Cooled Applications Only) 42
Fuel System Description 43
Electric Fuel Pump 43
Priming the Fuel System 43
Flame Arrestor 43
Serpentine Drive Belt 44
Changing Oils 45
Engine Alignment 46-49
Engine Maintenance Log 50
Maintenance Schedule 51-52
Visual Inspection 53
Engine Fluid Capacities 53
Transmission Fluid Capacities 53
Filter Requirements 54

TABLE OF CONTENTS

11 - ENGINE SPECIFICATIONS **55-56**
12 - OUT-OF-SEASON STORAGE **57-61**
Engine Storage 57
Draining Instructions 58
Battery Storage 58
Out-Of-Season Engine Warm-Up 59
Recommissioning After Storage 59-60
13 - TROUBLESHOOTING **61-64**
14 - WATER FLOW DIAGRAM **65**
15 - ENGINE HARNESS WIRING DIAGRAMS **66-67**
16 - LITERATURE **68**
17 - FORMS **69-73**
18 - NOTES **75**
CRUSADER WARRANTY / REGISTRATION FORM

SAFETY INFORMATION

"Safety Warnings" and additional information or instructions are used to alert the installer/operator of possible safety hazards in performing certain service or maintenance procedures incorrectly or carelessly. DANGERS and WARNINGS are accompanied by the international HAZARD symbol:

These "Safety Warnings" alone cannot eliminate the hazards that they signal. Strict compliance with these warning instructions while performing service and maintenance procedures, plus "common sense" operation, are major accident prevention measures.

REPLACEMENT PARTS

DANGER

Electrical, ignition and fuel system components are designed and manufactured to comply with U.S. Coast Guard rules and regulations to minimize the possibility of fire or explosion hazard.

Use of replacement parts (i.e. automotive, after-market, etc.) in the electrical, ignition and fuel systems, which are not U.S. Coast Guard approved, could cause a fire or explosion hazard and should be avoided.

Always request that genuine Crusader Marine Engines replacement parts be used in any repairs or maintenance being performed on your engine(s).

SAFETY WARNINGS

DANGER

Signals serious damage, failure or breakdown of equipment; severe injury or high probability of death to the user if proper precautions are not taken. This signal word is applied in extreme situations

WARNING

Indicates a potential hazard which could result in personal injury.

CAUTION

Indicates a hazard which could result in damage to equipment.

IMPORTANT: or ***IMPORTANT:*** Used to provide information to perform a procedure more easily.

WARRANTY NOTICE: Indicates a possible warranty exclusion.

OWNER'S SERVICE AND WARRANTY INFORMATION

CRUSADER MARINE ENGINES' COMMITMENT TO YOU

Crusader Marine Engines is committed to assuring your satisfaction with your new Crusader engine. Your Dealer also wants you to be completely satisfied, and invites you to return for all your servicing needs, both during and after the warranty period.

OWNER WARRANTY REGISTRATION

It is important that your selling dealer fill out the "Warranty Registration Card" completely and mail it to the factory immediately upon the purchase of the new product. It identifies the name and address of the original purchaser, product model(s) and serial number(s), and the selling dealer's name and address. The dealer is also certifying that you are the original purchaser of the product.

Upon receipt of the "Warranty Registration Card" at the factory, you will be issued an "Owner Warranty Registration Card." The "Owner Registration Card" is your only valid registration identification, and must be presented to the servicing dealer, should warranty service be required.

If your "Owner Registration Card" is not received within 30 days from the date of purchase, please contact your boat dealer or engine seller. The product warranty is not effective until the Product is registered at the factory.

Mail registration information to:

Crusader Marine Engines
P.O. Drawer 369
Little Mountain, SC 29075

NOTE: OWNERS WARRANTY REGISTRATION CARD IS LOCATED AT THE BACK OF THIS MANUAL.

NOTICE: Registration lists must be maintained by the factory and dealer on marine products sold in the United States and some foreign countries, should notification under **FEDERAL BOAT SAFETY ACT** be required. It is our desire to have all products registered at the factory, should it ever be necessary to contact you. Make sure your Dealer/Distributor fills out the registration card immediately and sends the card to the factory.

SERVICE and WARRANTY - 1

ENGINE OPERATION AND CARE

Considering the investment that you have made in your new Crusader engine(s), we know you will want to operate and maintain it properly. We urge you to follow the maintenance instructions contained in your engine's "Operation and Maintenance Manual."

If you have any questions on how to keep your engine in good working condition, see your selling dealer, the place where many owners choose to have their maintenance work done. Your dealer can be relied on to use proper parts and practices.

MAINTENANCE RECORDS

It is recommended that receipts covering the performance of regular maintenance be retained. Damage to your engine, caused by lack of maintenance, is not covered under your warranty. Receipts can be very important if a question arises as to whether a malfunction is caused by lack of maintenance or a defect in material or workmanship. An "Engine Maintenance Log" is provided in the MAINTENANCE SCHEDULE section of the OPERATION AND MAINTENANCE MANUAL for your convenience in recording the service performed.

LOCAL REPAIR SERVICE

To obtain service or make a claim under your warranty, contact your selling dealer. They have trained technicians, knowledge and special tools and equipment to properly service your engine, if the need arises. They know you and your boat best.

SERVICE AWAY FROM HOME

If you are away from home and your local dealer, and the need for service arises, contact the nearest authorized Crusader Marine Engines dealer. Refer to the yellow pages in the telephone directory. If, for any reason, you cannot obtain service, contact the Crusader Master Distributor closest to you for referral to the nearest authorized servicing dealer. (Refer to regional map and listing of Crusader Master Distributors on page 14.)

REPLACEMENT PART INQUIRIES

All inquiries concerning replacement parts should be directed to your local authorized dealer. The dealer has the necessary information to order parts for you if they are not in stock. Only authorized distributors can purchase parts from the factory. Crusader Marine Engines does not sell to unauthorized dealers or retail customers. When checking on parts, the dealer will require the engine model and serial number to order the correct parts.

REPLACEMENT SERVICE PARTS

WARNING

Electrical, ignition and fuel system components on Crusader Marine Engines are designed and manufactured to comply with U.S. Coast Guard rules and regulations to minimize the risks of fire or explosion. Use of replacement electrical, ignition or fuel system components, which do not comply with these rules and regulations, could result in a fire or explosion hazard and should be avoided.

When servicing the electrical, ignition and fuel systems, it is extremely important that all the components are properly installed and tightened. If not, any electrical or ignition component opening, if a fuel system leak were to exist, would permit sparks to ignite fuel vapors from the fuel system leaks.

APPLICABLE LIMITED WARRANTY

Following is the limited warranty applicable to Crusader Marine Engines sold and used in the United States and Canada.

Distributors and Dealers are not agents of Crusader Marine Engines. Crusader Marine Engines does not authorize any person to create any other obligation or liability in connection with this product.

CRUSADER, INC. INBOARD MARINE ENGINES

TWO YEAR LIMITED WARRANTY

(For Engines Sold and Used in the United States and Canada Only)

1. Crusader, Inc. (hereinafter referred to as “Crusader”) warrants each of its new inboard marine engines an accessories attached thereto (“Products”), to be free from defects in material and workmanship for a period of two (2) years, except to the extent limited herein. This Limited Warranty commences on the day of the first retail sale and/or the first date used, and extends to the original and subsequent retail sales; however, in no event shall the duration of the Limited Warranty exceed two (2) years, as measured from the original retail sale date.

2. Under this Limited Warranty, Crusader’s obligation is limited to repairing or replacing those parts of Products that have become defective within the applicable warranty period, because of defective materials or workmanship. Crusader will arrange for the correction of all defects under this Limited Warranty to be made free of charge at the selling dealership or an authorized Crusader service center. Crusader, in its discretion, may provide for the repair or replacement of any defective part at Crusader’s facility. Crusader will make payment for labor to replace such parts as provided in the, then, current flat rate labor manual or Warranty Procedures Manual.

3. This Limited Warranty does not apply to Product defects caused by normal wear and tear to Products, and/or damage to Products arising out of negligence or lack of proper care, improper installation or service, operation with fuels, oils or lubricants which are not suitable for use with Products, alterations or removal of parts, water entering an engine through the exhaust system or carburetor, installation of accessories or parts not manufactured or sold by Crusader, or Products rendered defective by accident.

4. If a part should become defective within the applicable warranty period, advance authorization by Crusader is necessary before the part is replaced or a defect is corrected by a service representative; otherwise Crusader will not be liable for the expense of the replacement or correction.

5. Replacement parts and accessories supplied by Crusader, and installed on a Product during the period when the Product is covered under the provisions of this Limited Warranty, are warranted for the unexpired portion of the existing warranty period, or ninety (90) days from the date of installation of such new parts or accessories, whichever is longer.

6. Reasonable access to the Product must be provided for warranty service. This Limited Warranty does not cover: (1) telephone or telegram charges, towing charges, storage, launch and haul out charges, loss or damage to personal property, loss of revenue, loss of time, travel, lodging, inconveniences or other CONSEQUENTIAL DAMAGES, or (2) removal and/or replacement of boat partitions or material, because of boat design, for necessary access to the Product.

7. **NO OTHER WARRANTY GIVEN**

   THE OBLIGATIONS SET FORTH IN THE PRECEDING PARAGRAPHS ARE CRUSADER'S SOLE OBLIGATIONS AND OWNER/USER'S EXCLUSIVE REMEDY. CRUSADER MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED (except to the extent provided in the immediately following paragraph), AND MAKES NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE.

   However, to the extent that any warranty may be implied by law, the term of such implied warranty shall be limited to a period of time corresponding to the period of express warranty applicable to the particular Product, and its use by the owner/user, as set forth herein, commencing on the date of the first retail sale of the Product to the first registered owner or registered user. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you.

   This is sole warranty provided respecting Crusader's Products, and no other party may make a warranty to owner/user.

   CRUSADER SHALL NOT BE LIABLE FOR ANY LOSS OF TIME, INCONVENIENCE, COMMERCIAL LOSS OR DIRECT OR INDIRECT, INCIDENTAL (except as specifically provided herein) OR CONSEQUENTIAL DAMAGES. Some state do not allow the exclusion or limitation of incidental or consequential damages, so this limitation or exclusion may not apply to you. This Warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

   Any owner/user hereby waives for himself/herself/itself and his/her/its successors and assigns (a) any and all claims for punitive damages, and (b) all claims of negligence or strict liability or both. In no event will Crusader's liability exceed the purchase price of the Products which is actually paid to Crusader.

8. To make a claim under this Limited Warranty, contact the selling dealer from which your Crusader powered boat was originally purchased or the nearest authorized Crusader servicing dealer. It is recommended that your warranty service be performed by the dealer which sold the Product to you because of that dealer's personal interest in you as a customer. Your Crusader powered Product must be delivered to the servicing dealer within the applicable warranty period. Proof of purchase may be required by the Crusader dealer to substantiate any warranty claim. Use your Crusader Owner Warranty Registration Card to establish proof of purchase.

9. ITEMS NOT COVERED UNDER LIMITED WARRANTY

This Limited Warranty is limited to defects in material and workmanship. To avoid misunderstandings regarding warranty coverage, the following describes some, but not all, of the more common types of service that are not covered by this Limited Warranty.

- Normal service requirements arising during the warranty period, such as fuel system or ignition adjustments, tune-ups, filter, adjusting controls or lubrications.
- Damage caused by neglect, lack of maintenance, abnormal operation accident or improper installation or service.
- Normal wear of the piston rings, cylinders, water pump and other engine parts.
- Haul out, launching, towing charges, dockage or storage fees, removal and/or replacement of boat partitions or material, because of boat design, for necessary access to the product.
- All related transportation charges and/or travel time.
- The cost of shipping replacement parts by air freight or other premium freight methods.
- Additional service work requested by the customer or performed by the dealer other than that necessary to satisfy the warranty obligation.
- Labor performed by other than an authorized dealer may be covered only under the following circumstances: when performed on an emergency basis (providing there are no authorized dealers in the area who can perform the work required, and prior factory approval has been given to have the work performed at this facility).
- Damage from participating in, or preparing for, racing or other competitive activity.
- Water entering the engine cylinders or oiling system through the intake manifold system, exhaust system, submersion, or in any manner if not caused by a Crusader manufacturing defect.
- Water in starters.
- Improper winterizing resulting in freezing and breaking of the engine block, cylinder heads, exhaust manifolds, heat exchanger or other damage.
- Repairs made necessary by normal wear, rust, electrolysis or corrosion, or by the use of the parts or accessories which are either incompatible with the Crusader product or adversely affect its operation, performance or durability.
- Valve or valve seat grinding required because of wear.
- Failure or damage due to lack of cooling water caused by starting the Product out of the water or by foreign material blocking the water inlets.
- Cleaning of the engine fuel system due to water or dirt contamination of the boat fuel system.
- Use of fuel and lubricants which are not suitable for use with or on the Product. Refer to the Operation and Maintenance Manual.
- Damage to the engine and/or transmission caused by striking a submerged object. (This is considered a marine hazard).

10. This Limited Warranty shall be governed by, and construed and interpreted in accordance with, the laws of the State of Ohio, without application of its conflicts of laws principles, except only to the extent replaced or precluded by other law of mandatory application.

11. SPECIAL STATE LEGAL REQUIREMENTS

This Warranty gives you specific legal rights, and you may also have other rights which vary from State to State.

The Crusader California Model Years 2003-2008 Emissions Warranty and California Emission Control Warranty Statement is a separate document included in this Manual. Any questions concerning the Emissions Warranty can be obtained by calling 1-803-345-0050.

THINGS YOU SHOULD KNOW ABOUT THE WARRANTY

Warranty Repair Component Exchanges

In the interest of customer satisfaction, Crusader Marine Engines may offer an exchange service on some engine components. This service is intended to reduce the amount of time that your boat is not available for use, due to repairs. Components used for the exchange service may be new, remanufactured, reconditioned or repaired, depending upon the component involved. All exchange components used meet Crusader standards and are warranted the same as new components.

Production Changes

Crusader Marine Engines and its Distributors reserve the right to make changes in the engines built and/or sold by it at any time without incurring any obligation to make the same or similar changes on engines previously built and/or sold.

Proof of Date of Purchase

Crusader will accept the return of a properly filled out “Warranty Registration Card”, supplied with each engine, as proof of purchase. Failure of purchaser to return such card will require the owner to provide a copy of the original “Bill of Sale” (sales contract) for the Product to be serviced. Warranty claims will not be accepted until adequate “Proof of Purchase” is presented by the purchaser, and the date of purchase is substantiated.

Access to Product

Reasonable access must be provided to the Product for warranty service. The warranty does not cover the removal and/or replacement of boat partitions and/or other components which must be removed for necessary access to the Product.

MARINE TRANSMISSIONS

Crusader Marine Engines are equipped with transmissions designed, built and warranted by other manufacturers. Although much of the transmission warranty is handled through Crusader Marine Engines, there may be issues for which, you, the owner, may want to contact the transmission manufacturer directly. The transmission suppliers are listed below for your reference. A tag is attached to each transmission showing the manufacturer, transmission model and serial number. Have this tag information available whenever contacting the manufacturer.

Velvet Drive Transmissions
1208 Old Norris Road
P.O. Box 238
Liberty, SC 29657
Phone: (864) 843-9234
www.velvetdrive.com

ZF Marine - Hurth Marine Transmissions
3131 SW 42nd Street
Ft. Lauderdale, FL 33312
Phone: (954) 581-4040

RESOLVING A SERVICE PROBLEM

Your satisfaction and faith in the product are of major importance to your dealer and to Crusader Marine Engines. Any problems with service, warranty or operation of your Crusader powered boat will be resolved by your dealer. He should be your primary source of information on your boat. Should there be a misunderstanding, or if your problem has not been resolved to your satisfaction, please follow these steps:

Step One - Discuss Your Problem With One Of The Dealership Management Personnel

Misunderstanding or complaints can be resolved quickly by the dealer. Discuss your problem with the dealership's service manager. If you are still unable to obtain satisfaction, contact the dealership's owner.

Step Two - If Your Complaint Has Not Been Resolved To Your Satisfaction, Contact The Distributor Closest To You (Refer to page 14 for a listing of Crusader Master Distributors.)

When contacting the nearest distributor, please provide the following information:

- Your name and address
- Daytime telephone number
- Engine model and serial number(s)
- Transmission model and serial number(s)
- Your dealer's name and location
- Date of purchase
- Present hours of operation
- Details of problem or complaint

Please remember that the distributor will first try to resolve the problems through your selling or servicing dealership, using the dealer's facilities, equipment and personnel. It is for this reason we request that you use the preceding steps when you have a problem. Experience has shown that this is the fastest method to obtain satisfaction.

ALL SERVICE WORK IS DONE BY AUTHORIZED DEALERS & SERVICING DISTRIBUTORS USING THE DEALER'S FACILITIES. NOT ALL CRUSADER DISTRIBUTORS MAY HAVE FACILITIES TO SERVICE OR REPAIR YOUR PRODUCT.

CRUSADER MARINE ENGINES
DISTRIBUTORS

Marysville Marine Distributors

Trans Pacific Distributors

AER Supply

Engine Distributors Inc.

Trans Pacific Distributors
1941 Walters Court
Fairfield, CA 94533
Henry Bramhall - Owner
Arley Harty
Phone: 800-688-6208
Fax: 707-426-0206
sales@marinegate.com

AER Supply
2301 NASA Road One
PO Box 349
Seabrook, TX 77586
Richard Miller
Phone: 800-767-7606
Fax: 281-474-2714
aersupply.com

Marysville Marine Distributors
282 Progress Way
Sun Prairie, WI 53590
Brian Hunter
Phone: 608-825-3878
Fax: 608-825-2790
marysvillemarine.com

Marysville Marine Distributors
1551 Michigan Avenue
Marysville, MI 48060
Steve Riehl
Phone: 810-364-7653
Fax: 810-364-4112
marysvillemarine.com

Marysville Marine Distributors
127 Industrial Dr.
White House, TN 37188
Randy Hall
Phone: 615-672-1142
Fax: 615-672-8084
marysvillemarine.com

Engine Distributors Inc.
400 University Court
Blackwood, NJ 08012
Jaime Cummins
Phone: 800-220-2700
Fax: 856-228-5657 - Parts
Fax: 856-228-5531 - Sales
jcummins@edi-dist.com

Engine Distributors Inc.
41 Pope Road
Holliston, MA 01746
Jaime Cummins
Phone: 800-220-2700
Fax: 856-228-5657 - Parts
Fax: 856-228-5531 - Sales
jcummins@edi-dist.com

Engine Distributors Inc. II
303 Interstate Dr.
Archdale, NC 27263-3148
Jaime Cummins
Phone: 800-220-2700
Fax: 856-228-5657 - Parts
Fax: 856-228-5531 - Sales
jcummins@edi-dist.com

Engine Distributors - Jacksonville
259 Ellis Road South
Jacksonville, FL 32254
Jaime Cummins
Phone: 800-220-2700
Fax: 856-228-5657 - Parts
Fax: 856-228-5531 - Sales
jcummins@edi-dist.com

Engine Distributors - Ft. Lauderdale
2917 SW 2nd Avenue
Ft. Lauderdale, FL 33315
Jaime Cummins
Phone: 800-220-2700
Fax: 856-228-5657 - Parts
Fax: 856-228-5531 - Sales
jcummins@edi-dist.com

DEALERS RESPONSIBILITIES

In general, the dealer's responsibilities to you, the customer, include pre-delivery inspection and preparation such as:

- Make sure that the boat is properly equipped
- Prior to delivery, make certain that the Crusader Engine is in proper operating condition
- Make all necessary adjustments for maximum efficiency
- Familiarize you, the owner, with the on-board equipment
- Explain and demonstrate the operation of the engine, and also the boat
- Explain warranty policies and deliver all operating manuals for the engine and the boat
- Complete the owner's warranty registration card and return it to the factory

TRANSFERABLE WARRANTY

The product limited warranty is transferable to a subsequent purchaser, but only for the remainder of the unused portion of the limited warranty. This will not apply to the products used for commercial applications.

DIRECT SALE BY OWNER

The second owner can be registered as the new owner, and may retain the unused portion of the limited warranty. The forms and instructions necessary to transfer the unused portion of the Crusader Two year Limited Warranty are provided in Forms, section 17 of this manual.

Upon receipt of the transfer application a new “Owner Warranty Registration Card” will be issued with the new owner’s name and address. Registration records will be changed on the factory computer registration file.

BOATING RESPONSIBILITIES - 2

CARBON MONOXIDE HAZARD

DANGER

Carbon Monoxide (CO) is a colorless, odorless and tasteless gas. You cannot see it, smell it or taste it. Prolonged exposure to carbon monoxide can lead to unconsciousness, brain damage or death!

Carbon monoxide is produced when anything that contains carbon, such as gasoline, natural gas, oil, propane, coal or wood is burned. Carbon monoxide is commonly found in the exhaust of internal combustion engines (boat power plants, generators, etc.). In addition, open flame devices like cooking ranges, heaters and charcoal grills also produce carbon monoxide.

Carbon monoxide accumulation, in and around boats is affected by vessel geometry; overall vessel design; closeness to other structures; wind direction; boat speed; and many other variables. In no way can this section cover all of the possible variables. Do not rely on this section as the exclusive listing of measures to prevent the accumulation of carbon monoxide.

Consult your boat operators manual for detailed information on the inspection and/or maintenance of the exhaust system for your particular application. If an inspection reveals possible leaks, DO NOT operate your engine(s) until it can be serviced by a qualified technician.

Proper and adequate air circulation, around and throughout the boat, is absolutely necessary to aid in the prevention of carbon monoxide build-up. If you have any questions or concerns regarding the operation of your boat and carbon monoxide hazards, DO NOT operate your engines until you have contacted your boat manufacturer.

To find out more about making boating safer, including how you can prevent carbon monoxide poisoning on recreational boats, contact:

National Marine Manufacturers Association
200 East Randolph Drive
Suite 5100
Chicago, IL 60601-6528
www.nmma.org
312-946-6200

United States Coast Guard
Office of Boating Safety
CG Headquarters G-OPB-3
2100 Second Street SW
Washington, DC 20593
www.uscgboating.org
202-267-0984

American Boat & Yacht Council, Inc.
3069 Solomon's Island Road
Edgewater, MD 21037-1416
www.abyc.com
410-956-1050

SAFE BOATING SUGGESTIONS

The nation's waterways are becoming increasingly crowded and, in order to enjoy them safely, the operator should acquaint himself/herself with safe boating practices. Boating safely and seamanship courses are offered by the following national and state organizations:

- Power Squadrons
- Coast Guard Auxiliary
- Red Cross
- State, provincial or local agencies in charge of water safety enforcement

Crusader Marine Engines highly recommends that all power boat operators attend one of these courses. To help locate a course being offered near you, contact Boat U.S. Foundation's toll-free national boating safety hotline, 1-800-336-BOAT, and in Virginia, 1-800-245-BOAT.

WATER WISDOM

The following are suggestions for safe operation of your boat to ensure the safety of yourself and your passengers:

- Know your boat's loading and operating limitations. DO NOT OVERLOAD!
- Make periodic checks of safety equipment onboard.
- Do not consume alcoholic beverages or take illegal drugs when operating a boat. Some state laws apply to boats as well as motor vehicles.
- File a "float plan." Let someone know your destination and your expected time of return.
- Monitor the weather. Know the signs of weather change and avoid severe weather and rough seas whenever possible.
- Follow the "Rules of the Road" when boating. Always be on the alert and watch out for "the other guy."
- Plan and chart your course. Be aware of, and avoid, hazardous areas.
- Be sure your boat is equipped with the required safety equipment. Check with the Coast Guard and local government agencies as to the regulations and restrictions in your area. Contact your local Coast Guard Auxiliary and take advantage of their seasonal boat inspections.

The following is a list of suggested safety equipment and spare parts which may be useful in case of an emergency:

- Approved personal flotation devices (life jackets); one for each person on board.
- Approved throwable personal flotation device for man-overboard protection.
- Approved fire extinguishers
- Signal devices: flares, spotlight, signal flag and horn or whistle
- Crusader Marine Engines' "Onboard Kit," plus spare fuses, bulbs, batteries, etc. Tools necessary for minor repairs
- Spare propeller
- Anchor and anchor line
- First aid kit and first aid book
- Ship-to-shore radio, compass and chart of the area in which you are traveling
- Manual bilge pump and spare drain plugs
- Waterproof storage containers

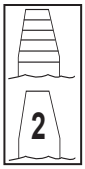
OPERATION AND MAINTENANCE

It is the owner's/operator's responsibility to perform all safety checks before operating his/her boat. All lubrication and maintenance schedules must be adhered to assure optimum performance and dependability from your Crusader engine. When service and maintenance are required, return to your authorized Crusader Marine Engines Dealer.

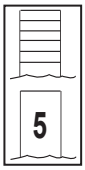
BOATING RESPONSIBILITIES - 2

RULES OF THE ROAD
Channel Buoy Guide

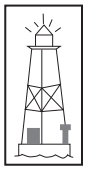
The color of the paint is the only characteristic which has the same meaning on all buoys. Red buoys always indicate the starboard side of the channel from seaward. (Red Right Returning)



1. **Nun Buoy:** This buoy indicates the starboard side of the channel when returning from sea. It is conical shape, the color red and indicates even numbers. A nun buoy with red and green horizontal bands (top band red), and not numbered, indicates an obstruction. The principal channel is to the left of the buoy when returning from sea.

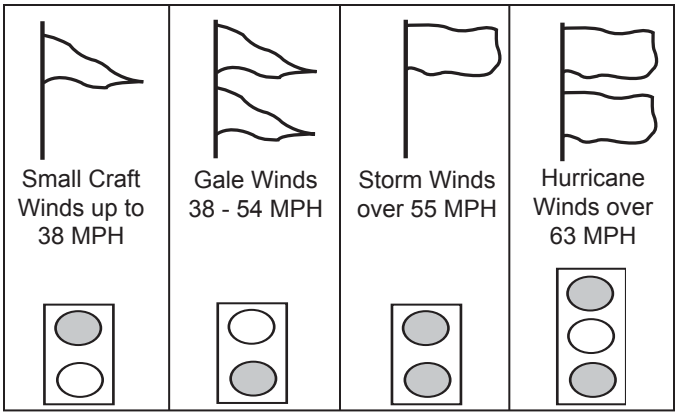


2. **Can Buoy:** This buoy indicates the port side of the channel when returning from sea. It is cylindrical shape, the color green and indicates odd numbers. A can buoy with green and red horizontal bands (top band green), and not numbered, indicates an obstruction. The principal channel is to the right of the buoy when returning from sea.



3. **Lighted Buoy (RED):** This buoy has a flashing red light. It indicates the starboard side of the channel when returning from sea.

4. **Lighted Buoy (GREEN):** This buoy has a quick flashing green light. It indicates the port side of the channel when returning from sea. The quick flashing light indicates special caution required.



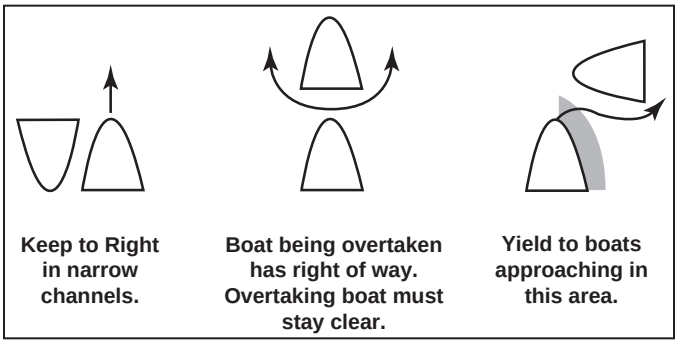
Storm Warning Signals - Pennants (by day)
Lights (by night)

Boat Capacity

- Load only to manufacturer's specifications
- Distribute load evenly; keep it low
- Passengers should only ride on the parts of the boat that are designed for that purpose
- If water is rough, carry fewer passengers

Observe the Rules of the Road

PORT (Left) - Leaving the harbor with green buoys to your right.
STARBOARD (Right) - Entering the harbor with red buoys to your right.


Keep to Right in narrow channels.
Boat being overtaken has right of way. Overtaking boat must stay clear.
Yield to boats approaching in this area.

Know Your Horn Signals

1 Short Blast = Passing you on my port side
2 Short Blasts = Passing you on my starboard side
3 Short Blasts = I am going astern
5 Short Blasts = Danger
Always refer to the latest U.S. Coast Guard Navigation Rules CG-169.

Keep An Alert Lookout For:

Bad weather, Swimmers, Other boats, Water skiers, Fisherman, Divers and/or any other obstructions

Keep Your Wake Under Control, particularly upon entering or leaving harbor areas. You are responsible for wake damage to other vessels and/or property.

Do Not Fool With Fuel

1/2 pint of gasoline = 15 sticks of dynamite

1. During fueling, moor boat properly; remove all passengers.
2. Keep all doors, hatches and ports closed.
3. Shut down all electronic gear; extinguish galley fires, pilot lights and smoking materials.
4. Do not overload tanks.
5. Keep filling nozzles in contact with the fill pipe to prevent sparks.
6. Secure the fill cap tightly; wipe away any spillage.
7. Ventilate all components for a minimum of five minutes before starting engines.
8. Keep fuel lines and bilges clean.

ENGINE IDENTIFICATION

When ordering service parts or obtaining information, always give the engine model and the serial number. This information can be found on the following decal.

MAKE
MODEL
SERIAL
FIRING ORDER
THIS ENGINE CONFORMS TO ALL APPLICABLE U.S. GOVERNMENT STANDARDS FOR MARINE ENGINES IN EFFECT AT DATE OF MANUFACTURE.
LITTLE MOUNTAIN, SC 29075

Figure 3-1 Engine Identification Decal

OWNER IDENTIFICATION AND REGISTRATION INFORMATION

We suggest that you record the following information for quick reference when ordering parts or requesting service or warranty.

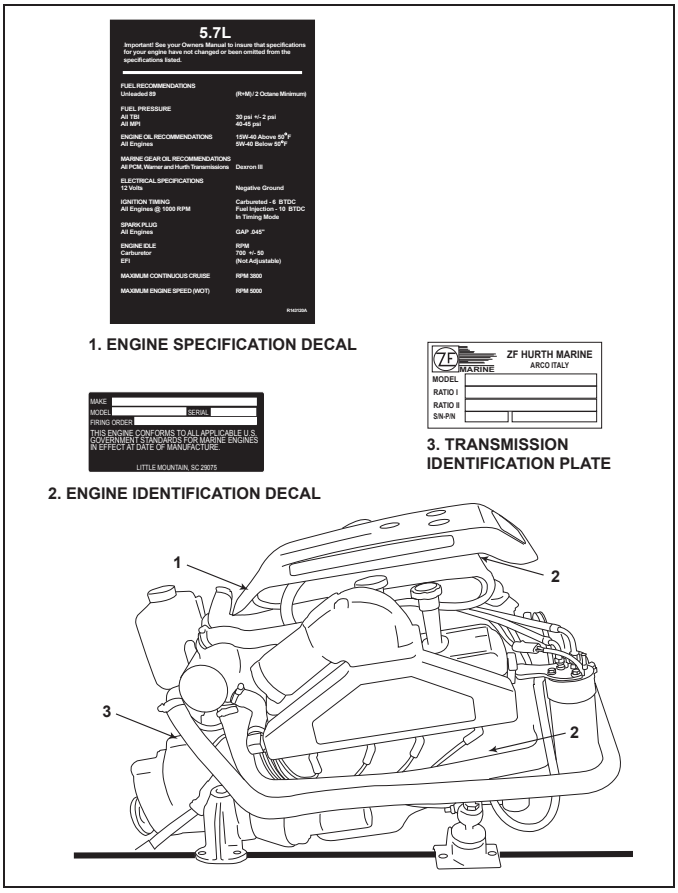


Figure 3-2 Engine Identification Tag Locations (5.7L) (Typical)

	PORT	STARBOARD
Engine Model Number:		
Serial Number(s):		
Gear Model Number:		
Serial Number(s):		
Boat Make:		
Boat Model:		
Hull Serial Number:		
Propeller Size:		
Ignition Key Number:		

CRUSADER
MODEL IDENTIFICATION / ADVISORY

MODEL **50 - 572 V - 0 1** SERIAL **690000**

1st - 2nd Space: **MANUFACTURING CODE**

3rd - 5th Space: **ENGINE CODE**

572 =	5.7L	(350 CID LH Carburetor)	(GM)
573 =	5.7L	(350 CID RH Carburetor)	(GM)
502 =	5.0L	(305 CID LH Carburetor)	(GM)
503 =	5.0L	(305 CID RH Carburetor)	(GM)

6th - 8th Space: **DRIVE CONFIGURATION**

blank - Direct Drive

V - V-Drive

9th - 10th Space: **SPECIFICATION CODE**

SERIAL NUMBER I.D.

1st DIGIT INDICATES DECADE ENGINE WAS MANUFACTURED (5 = 1990, 6 = 2000, 7 = 2010)

2nd DIGIT INDICATES CALENDAR YEAR ENGINE WAS MANUFACTURED.

INSTRUMENTATION

Boat manufacturers install many different types of instrumentation on boats. Become familiar with the instrumentation on your boat and be aware of abnormal operating conditions. The following is a brief explanation of typical instrumentation found on most boats:

1. Tachometer - indicates the engine RPM (revolutions per minute)
2. Engine Synchronizer (twin engines only)
3. Water Temperature Gauge - indicates the engine coolant temperature
4. Oil Pressure Gauge - indicates the engine oil pressure
5. Voltmeter - indicates the battery voltage and charging system voltage
6. Hour Meter - indicates the engine operating time
7. Fuel Level Gauge - indicates the fuel tank level
8. Malfunction Indicator Lamp (MIL) or Check Engine Lamp - (tpical for MPI engines) indicates a problem with the engine control system

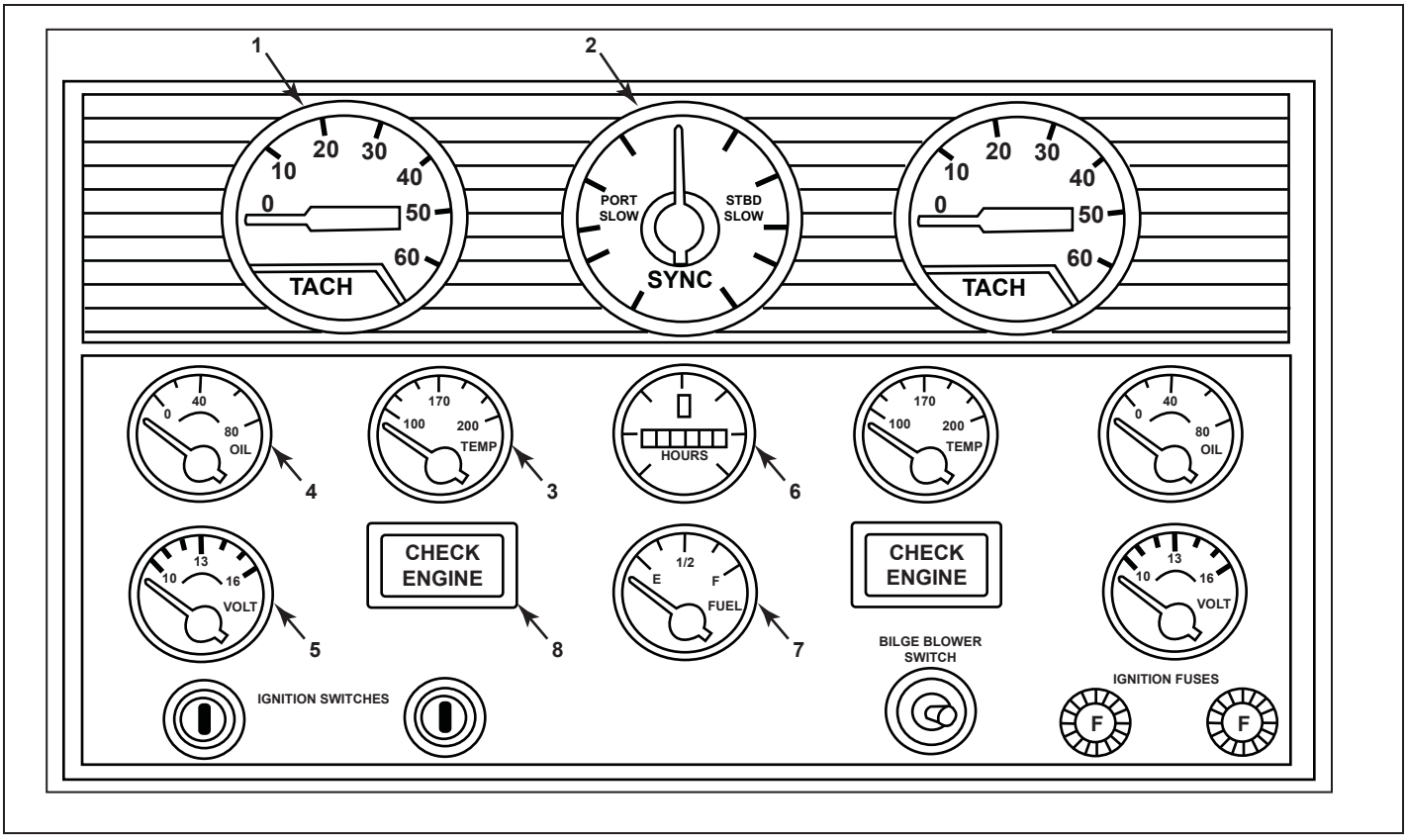


Figure 4-1 Typical Instrument Panel

ENGINE ALARM SYSTEM

Crusader Marine Engines come equipped with a provision for an audible and/or visual engine alarm system. The purpose of this alarm is to warn the boat operator of a potential problem before an engine failure occurs.

NOTE: Some boat builders may install their own alarm system. It is recommended that the boat owner check with his dealer for an explanation of the particular alarm system installed and how it functions if different than shown.

The alarm comes with a remote warning buzzer which is mounted near the control station so it is audible to the operator at all times. The buzzer will sound when first starting the engine and stop when minimum oil pressure is obtained. This also lets the boat operator know the alarm system is functional.

During normal engine operation, the warning buzzer will sound only when one of the following operation deficiencies becomes apparent:

1. Engine coolant temperature exceeds 210°F (100°C).

2. Engine oil pressure drops below 10 PSI (69 kPa).

If the warning buzzer sounds during engine operation:

1. Throttle back to idle speed immediately.

2. Quickly observe the water temperature and oil pressure gauges.

3. If low or no oil pressure is indicated, immediately stop engine.

4. If the water temperature gauge indicates an overheating problem, operate at idle speed for a couple of minutes. If the temperature gauge continues to indicate an engine overheat, stop engine.

5. Make needed repairs before restarting engine. Locating and correcting a malfunction immediately will save unnecessary down-time and costly repairs can be prevented.

REMOTE CONTROLS

Your boat may be equipped with one of many different types of remote controls available. Ask you dealer for a description and/or demonstration of the particular type installed on your boat.

CAUTION

Never shift transmission into or out of gear unless throttle is at the idle position. Shifting transmission above 1000 RPM can severely damage boat, transmission and engine.

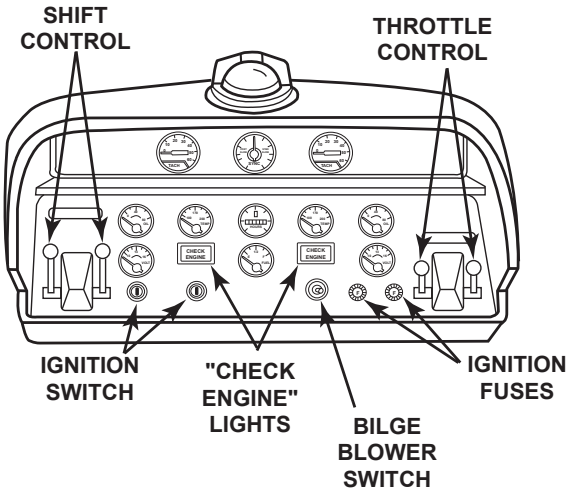


Figure 4-2 Typical Dash Layout

STARTING ENGINE

WARNING

Before starting engine, ventilate the engine compartment by operating the bilge blower for a minimum of five minutes to remove any gas fumes from engine compartment. If boat is not equipped with blower, open engine compartment hatches to ventilate and leave open while starting engine.

IMPORTANT: Do not start the engine without water being supplied to the sea water pick-up pump or sea-water pump impeller will be damaged, and subsequent overheating damage to the engine may result.

IMPORTANT: The following items should be checked before starting the engine, and each time the boat is operated:

- Fuel system for any signs of leakage
- Operation of remote controls and steering
- Engine and transmission oil levels
- Fuel tank levels
- Exhaust system for leaks and tightness of the clamps
- Battery connections and water level in battery cells
- Accessory drive belt
- Cooling system for leaks. If equipped with fresh-water cooling, check coolant level in recovery bottle. Check for signs of water leaks at the exhaust manifolds, risers and elbows (Figure 4-2A). If the water is leaking externally, it is possible that the water is also leaking internally. This could result in internal engine damage. It is very important to service these maintenance items as soon as a problem is indicated.

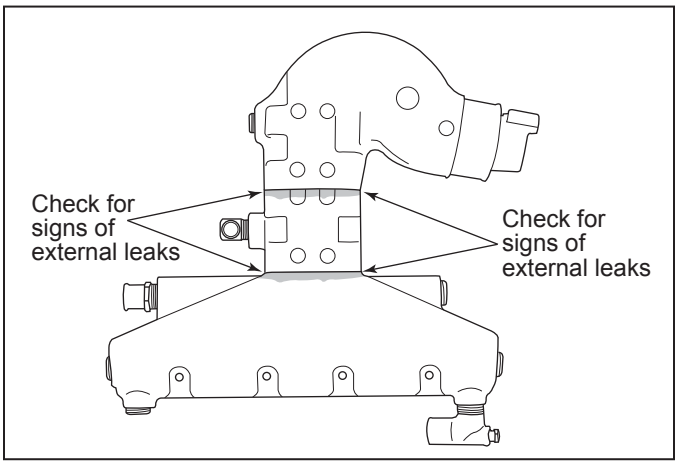


Figure 4-2A Water Leaks

After performing the initial safety checks, proceed as follows to start the engine:

1. Turn the battery switch ON (if equipped).
2. Open the fuel valve.
3. Open the sea cock.
4. Place the remote control in Neutral position. The transmission is equipped with a neutral safety switch, which will not allow the starter motor to operate unless the transmission is in neutral.
5. Position throttle control lever as follows:
   - Cold Engine - Pump throttle lever once and return to approximately ¼ throttle.
   - Warm Engine - Place throttle lever at approximately ¼ throttle.
   - Flooded Engine - Place throttle lever at wide open throttle. Be prepared to quickly decrease engine speed when engine starts.
6. Turn the ignition key to the start position. When the engine starts, release the key.

IMPORTANT: If the engine fails to start within 20-30 seconds, turn the ignition key to the OFF position and allow 2 minutes for the starter motor to cool off before attempting to restart the engine.

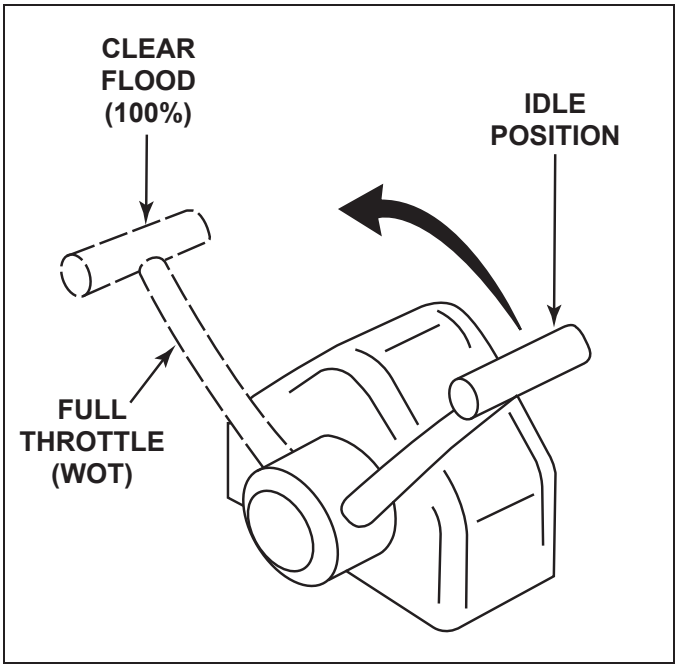


Figure 4-3 Throttle Position Setting

NOTICE: If engine still fails to start, contact your Crusader Marine Engines Dealer for service.

7. Check engine oil pressure immediately after the engine starts. If oil pressure is not within specifications (see Engine Specifications), immediately stop the engine and determine the cause.

8. Check voltmeter for proper charging system operation.

9. Check the engine and transmission for fuel, oil, water and exhaust leaks.

10. Allow the engine to reach normal operating temperature. Check the temperature gauge to ensure the engine is operating within the normal temperature range. If the temperature is abnormally high, stop the engine immediately and determine the cause.

SHIFTING TRANSMISSION

CAUTION

Engine must be properly aligned or vibration, noise and damage to the transmission output shaft seal and bearings may result.

CAUTION

Never shift the transmission into or out of gear unless the throttle is at the idle position. Shifting the transmission above 1000 RPM can severely damage the boat, transmission and engine.

1. Set the throttle lever at the idle position.

2. Move the transmission lever ***completely forward*** to shift into Forward gear.

3. Move the transmission lever ***completely backward*** to shift into Reverse gear.

4. Move the transmission lever to the ***center detent*** position to shift into Neutral.

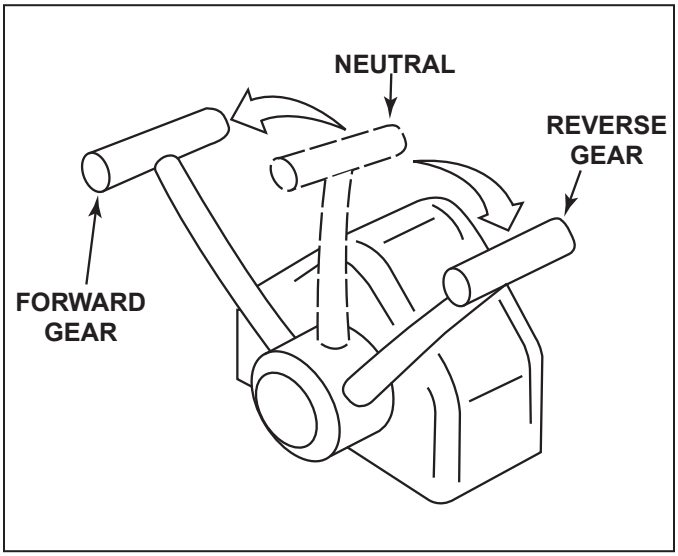


Figure 4-4 Shift Control

STOPPING ENGINE

When returning to the dock, or whenever stopping the engine, bring the throttle back to the idle position. After the engine reaches idle speed, turn the ignition key to the OFF position.

Before stopping the engine after extended high speed operation, allow the engine to idle at 1200 RPM for 3 to 5 minutes to allow the engine to cool down before shutting off the ignition.

After stopping the engine, complete the following:

1. Turn the battery switch OFF, if equipped.
2. Close the fuel valve.
3. Close the sea cock.
4. Flush the cooling system if in a salt water area.

FREEZING TEMPERATURE OPERATION

If the possibility of freezing exists, the cooling system must be protected after the engine is shut off to prevent freeze damage to the engine. Refer to OUT-OF-SEASON STORAGE for draining instructions.

OPERATION IN HIGH DEBRIS AREAS

If the boat is to be operated in high debris areas, a sea strainer should be installed in the water inlet hose to prevent debris from entering the cooling system. The strainer used must be of sufficient size to allow an adequate supply of water for cooling the engine. A minimum of 30 gallons per minute (114 liters per minute) flow rate is required.

TRIM AND WEIGHT DISTRIBUTION

Trimming of the boat and positioning of the weight (gear and passengers) inside the boat has the following effects on handling:

- Trimming the bow up or shifting weight to the stern (rear).
  - Normally used for cruising (running) with a choppy wave condition (following sea) for running at full speed
  - Will generally increase speed and engine RPM
  - Will cause the bow to bounce in rough water
  - In extreme, may cause the boat to porpoise
  - When coming off plane, it increases the chances of following wave splashing into the stern of the boat
- Trimming the bow down or shifting the weight to the bow (front)
  - Normally used for cruising (running) against a choppy wave condition, acceleration onto plane and operating at slow planing speeds
  - Will improve rough water ride and handling
  - In extreme, may cause the boat to bow steer (veer back and forth with little control)

BOAT BOTTOM

To ensure maximum engine performance, fuel economy and boat speed, the bottom of your boat must be kept clean and free of marine growth and barnacles. Marine vegetation may accumulate when the boat is docked and should be removed before operation. If the boat is docked for long periods of time, the water inlets may become clogged with growth and will cause the engine to overheat.

In most areas, it is advisable to coat the boat bottom with antifouling paint to prevent the build-up of marine growth. Contact your dealer for advice on these requirements in your area.

PROPELLER SELECTION

Best all-around performance and maximum engine life is achieved when the engine is propped to run near the top of (but within) the recommended full throttle RPM range with a normal load. See ENGINE SPECIFICATIONS for rated full throttle RPM for your model engine.

Generally, gross weight (total weight of the entire boat, including full fuel and water, optional equipment, passengers and other miscellaneous gear) is one of the major factors and should be one of the primary considerations when selecting a propeller. Other factors to take into consideration are as follows:

- Warmer weather and higher humidity will cause an RPM loss.
- Operating the boat in a higher elevation will cause an RPM loss.
- Operating the boat with an increased load will cause an RPM loss (additional equipment, passengers, etc.).

If full throttle RPM is above or below the recommended range as stated in ENGINE SPECIFICATIONS, the propeller must be changed to prevent loss of performance. A one-inch change in the pitch of a given propeller will generally change engine RPM by 150 to 250 RPM.

ENGINE RPM CHART

Model	Minimum Full Load	Preferred	Maximum
XL 5.7L	4800	5000	5200

CAUTION

Prolonged WOT operation will shorten the life of your engine and could cause premature engine failure. See NORMAL CRUISING SPEEDS in SPECIFICATIONS. Problems caused by WOT operation are considered abuse and are not covered under the Crusader Warranty.

WARNING

Use this procedure ONLY when conditions are such that it can be performed in complete safety.

The break-in period of your engine is the first 25 hours of operation. Proper engine break-in is essential to achieve maximum performance, longevity and minimum oil consumption. During the break-in period, the following operation guidelines must be adhered to:

- After the engine is thoroughly warmed up, and the boat is underway, open the throttle to wide open throttle until maximum RPM is reached. DO NOT EXCEED MAXIMUM RPM. (RPM should cease climbing after 10 to 20 seconds).

CAUTION

DO NOT operate at full throttle in neutral at any time, or at sustained full throttle during the first 5 hours of operation. Thereafter, use sustained wide open throttle only in the event of an emergency.

- Reduce the throttle to 2800 - 3000 RPM, and cruise at or below this speed for 1/2 hour. Reduce the speed to idle. Go to wide open throttle until maximum RPM is reached and operate for approximately 30 seconds. Reduce throttle to 2800-3000 RPM and operate for a few minutes. (Bringing the engine speed from idle to wide open throttle will load the engine and assist in seating the piston rings). This cycle can be repeated from time to time during the first 5 hours of operation, but wide open throttle should not be sustained for more than 1 to 2 minutes.

- During the early part of the break in period, the correct propeller selection can be confirmed. (With a normal load aboard, the engine's RPM should reach, but not exceed, the maximum RPM as listed in the specifications section).

- During the break in, all gauges should be watched carefully, and the speed should be reduced if abnormal readings become evident.

CAUTION

DO NOT attempt to break in any engine by prolong idling, or running at the dock.

The engine oil level should be checked often and oil added when necessary. It must be understood that every internal combustion engine will use a certain amount of oil during operation to act as a lubricating and cooling agent, especially during the break-in period. Oil consumption should decrease and become stabilized after approximately 100 hours of operation.

At the end of your 25-hour break-in period, contact your dealer and have the recommended 25-hour inspection done.

NOTICE: Crusader Marine Engines assumes no responsibility for the costs related to the 25-hour inspection. This is the owner's responsibility.

25-HOUR ENGINE INSPECTION - 7

After the first 25 hours of operation, it is recommended that the engine be given an inspection. Your boat dealer or a Crusader Premier servicing dealer should be contacted to perform the necessary checks and adjustments to ensure the proper engine performance. The following maintenance should be performed:

- Change the engine oil and filter.
- Ignition system - Inspect ignition system and adjust timing, if necessary.
- Replace the primary fuel filter.
- Check the engine alignment.
- Inspect the accessory drive belt(s) and check the tension.
- Check all the fluid levels.
- Check the throttle and the shift cable adjustments and check for freedom of movement.
- Cooling System - Inspect all the hoses for leaks, damage and deterioration. Check all the hose clamps for adequate tightness.
- Exhaust System - Inspect the entire exhaust system for leaks, damage and deterioration. Check all the hose clamps for adequate tightness.
- Battery - Check the electrolyte level and specific gravity. Inspect the case for damage. Check the battery cables and connections.
- Engine Assembly - Check for loose, missing or damaged parts. Pay close attention to engine mounts, starter and alternator mounting fasteners.

NOTICE: Crusader Marine Engines assumes no responsibility for the costs related to the 25-hour inspection. This is the owner's responsibility.

GASOLINE REQUIREMENTS

CAUTION

Fire and Explosion Hazard - Gasoline is extremely flammable and highly explosive, and , if ignited, can cause serious bodily injury or death. Careful inspection of the entire fuel system including, but not limited to, fuel tanks, fuel lines, fuel filters and all fittings is mandatory, especially after periods of storage. Replace any component that shows signs of leakage, corrosion, deterioration, swelling, hardening or softening.

WARRANTY NOTICE: Damage caused to the engine through the use of improper gasoline, low-quality or gasoline with an octane rating below the minimum requirements listed below, is considered misuse of the engine. Such damage is not covered by the Crusader Marine Engines warranty.

The ignition timing set by the factory requires the use of a high-quality lead-free regular gasoline with the following octane specification.

Pump Octane Number (R+M/2) (PUMP) - 87

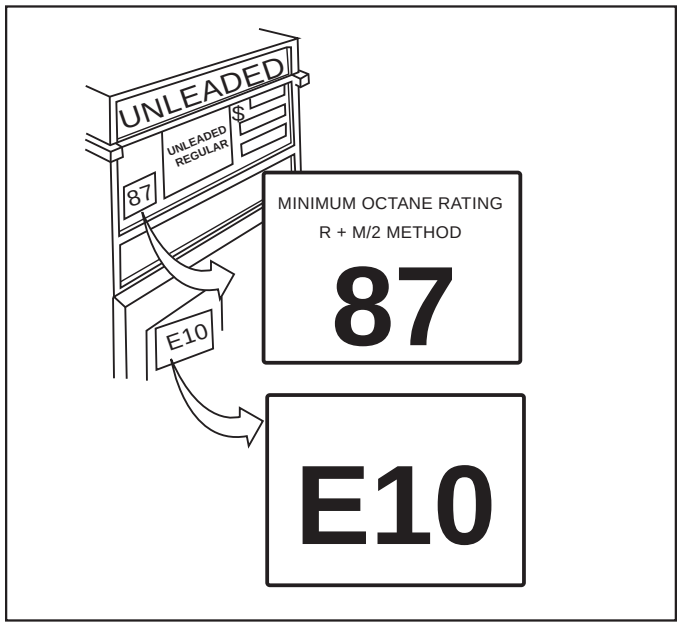


Figure 9-1 Fuel Requirements

NOTICE: Most Crusader Fuel Injected engines are calibrated to operate on 87 octane fuel and maximum performance is obtained when using this fuel. Some applications may require a higher octane fuel. These particular applications will be noted.

If a slight pinging is heard during acceleration and the proper octane fuel is being used, it is considered normal. If a constant, heavy knock occurs, the engine should be evaluated by a Crusader Marine Engines service technician.

GASOLINE CONTAINING ALCOHOL

The implementation of ethanol-based fuel is spreading rapidly throughout the United States. As such, Crusader Engines provides the following information regarding the use of this fuel.

This information addresses the use of ethanol fuels in CRUSADER ENGINES ONLY. It does not address the use of ethanol fuels in vessel related components such as boat gas tanks, boat fuel lines, etc.

Ethanol blended fuel rated E10 or less is acceptable to use. Fuels rated higher than E10 SHOULD NOT BE USED. Ethanol fuels rated higher than E10 could potentially damage the engine and/or present an unsafe boating condition. Damage to the engine resulting from the use of ethanol fuel rated higher than E10 IS NOT covered by the warranty.

CAUTION

Do Not use any gasoline that contains METHANOL. This fuel is very corrosive and will create unsafe operating conditions. Serious damage will result from the continued use of fuel containing METHANOL. Any resulting engine damage will not be covered by the warranty.

If ethanol blended fuel rated E10 or less is used, or if the presence of alcohol is uncertain, more frequent inspections and service of the complete fuel system are required. Any sign of fuel leakage or deterioration must be repaired immediately before further engine operation.

It is important to note that ethanol blended fuel will act as a solvent and will attract and hold moisture. ***Without proper fuel stabilization and fuel filtration, ethanol blended fuel may cause the following:***

- Excessive moisture (water) may cause lean operation to include hard starting and operating difficulties such as, vapor lock, low speed stalling, and shortened fuel shelf life.
- Acting as a solvent, ethanol blended fuel may cause gum, sediment, sludge, and other particles to be loosened and carried through the fuel system to the engine.

Fuel system or engine damage caused by contamination from water, foreign particles, sludge, or gums entering or forming in the fuel system is not covered by the Crusader Limited Warranty.

Fuel Stabilizer Recommendations for Ethanol Blend Fuel

The use of a commercially available fuel stabilizer, such as STA-BIL®, is recommended when storing ethanol-blended fuel for more than ***2 weeks***.

PISTON DAMAGE DUE TO DETONATION AND /OR PRE-IGNITION

WARRANTY NOTICE: Engine failure due to detonation and/or pre-ignition is not a defect in material or workmanship. Warranty coverage may not apply to these types of engine failures unless it is proved the failure was caused by a defective part.

Detonation, commonly called “spark knock” or “fuel knock,” is abnormal combustion of the fuel which causes the fuel to explode violently within the combustion chamber.

Normal burning or combustion in a four-cycle engine starts at the spark plug, and a wave of flame moves across the combustion chamber. This results in a smooth pressure rise in the combustion chamber which pushes the piston downward.

Detonation starts out as normal combustion with the spark-ignited flame progressing across the combustion chamber while applying heat and pressure to the unburned portion of fuel. Then, instead of continuing to burn smoothly and evenly, the last portion of fuel explodes violently, causing overheating of the spark plugs, pistons and valves.

Detonation can occur at any engine speed. It is often not detected because of normal operation noises and well-insulated engine compartments. Undetected detonation may result in serious engine damage.

The use of low-octane gasoline is one of the most common causes of detonation. Even when using proper gasoline, detonation can occur if engine maintenance is neglected. Some other causes of detonation are:

- Improper gasoline quality (octane - R.V.P.)
- Improper propeller selection (lugging engine - inability of engines to reach rated WOT RPM)
- Improper initial timing setting (power timing)
- Engine overheating. Improper cooling system operation resulting in overheating condition
- Fuel system vapor lock (poor fuel quality, lean fuel mixture)
- Improper carburetor function (water and/or dirt), (float setting) causing lean mixture
- Operating twin engine boat on one engine at high throttle setting resulting in overload.
- Operating engine with dead cylinder, out of proper tune or wired with improper firing order. Defective distributor cap (carbon tracked).
- Excessive exhaust back-pressure caused by restrictive mufflers and/or collectors or undersized exhaust outlets.

ENGINE OIL RECOMMENDATIONS

Use of Supplemental Additives

Engine oils meeting Crusader Marine Engines' recommendations already contain a balanced additive treatment. The use of supplemental additives which are added to the engine oil by the customer are unnecessary and may be harmful. Crusader Marine Engines does not review, approve or recommend such products.

Synthetic Oils

Synthetic engine oils may be used in Crusader Marine Engines. Synthetic oils must meet the Engine Oil Requirements for Classification and Viscosity listed below. The use of synthetic oil **does not** permit the extension of oil change intervals.

Engine Oil Requirements

The following chart shows the recommended oil viscosity for various ambient temperature ranges:

Prevailing Ambient Temperature	Recommended A.P.I. Classification & Viscosity
Above 50˚F	SAE 15W-40 "GF-4/SM"
Below 50˚F	SAE 5W-30 "GF-4/SM"

IMPORTANT: The use of oils which contain "solid" additives, non-detergent oils or low quality oils specifically are not recommended.

WARRANTY NOTICE: Crusader Marine Engines reserves the right to refuse warranty on part(s) and/or engine(s) damaged by using improper fuels and engine oils.

Oil Change Intervals (Common)

Crankcase oil and oil filter change - Recommended intervals:

- Initial oil change - 1st 60 days or 25 hours of operation, whichever occurs first
- Regular oil changes - Every 50 hours of operation or 120 days, whichever occurs first

TRANSMISSION AND "V"-DRIVE OIL REQUIREMENTS

Transmission and "V" Drive	Recommended A.P.I. Classification and Viscosity
Velvet Drive Transmissions and "V" Drives - All	Dexron III Automatic Transmission Fluid (ATF) or equivalent
Walters "V"-Drive	Exxon Spartan EP-68 or SAE 30 Engine Oil
All Hurth Gear Transmissions	Dexron III Automatic Transmission Fluid (ATF) or equivalent
Crusader 4500 "V" - Drive	SAE 80W-90 Gear Oil

NOTICE: WALTERS "V"-DRIVES ONLY - A low oil pressure warning light is mounted on Walters "V"-Drives. The warning light will stay illuminated until the boat gets underway, and the engine speed increases to sufficient RPM for the pump to maintain pressure. This normally occurs at approximately 1200 RPM. Extended cruising at low RPM, such as when trolling, is not harmful to the "V"-drive, even though the warning light may remain illuminated.

ENGINE MAINTENANCE

Refer to the MAINTENANCE SCHEDULE for a complete listing of required maintenance and the frequency at which it should be performed. Some procedures may be performed by the owner/operator while others should be performed by an authorized Crusader Marine Engines Premier Dealer. Before performing any maintenance or repair procedure not covered in this manual, it is strongly recommended that a Crusader Marine Engines repair manual be purchased and read thoroughly.

CHECKING FLUID LEVELS

Engine Crankcase Oil

CAUTION

Do not overfill engine crankcase with oil, as excess oil will be splashed by reciprocating engine parts onto the cylinder walls in greater quantity than the rings can control. The oil, subsequently, will be drawn into the combustion chamber and burned. Continuous operation under these conditions can cause carbon to form on combustion chamber surfaces, which will adversely affect engine performance and may lead to premature engine failure. Splashing or agitation of oil also may cause it to become aerated, which will affect the oil pressure, and may result in internal engine damage from lack of lubrication.

1. Stop the engine if running. Allow approximately 5 minutes for the oil to drain back into the oil pan.

2. Remove the dipstick, wipe it clean, and reinstall it fully into the dipstick tube.

3. Remove the dipstick and observe the oil level. The oil level must be between the “FULL” and “ADD” marks. If the oil level is below the “ADD” mark, add specified oil to bring the level up to, but not over, the “FULL” mark on the dipstick. (Figure 10-1).

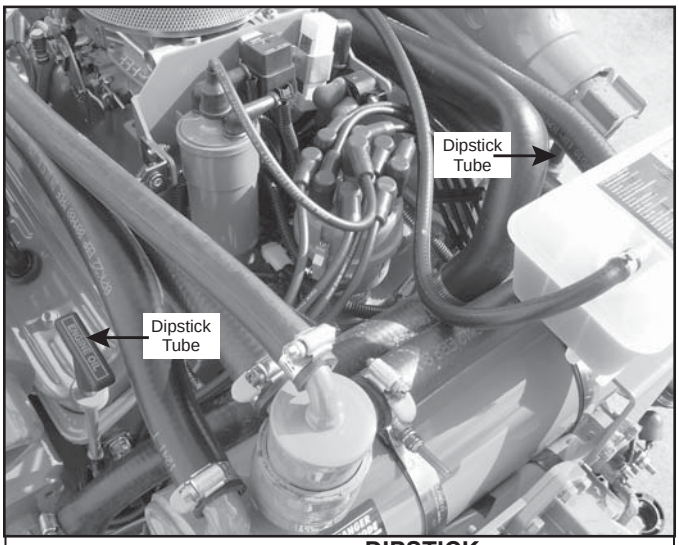


Figure 10-1 Engine Oil Dipstick (Typical)

WARNING

The machinery space must be closed anytime the engine is running to prevent injury to you or others on board. Never operate the engine with the engine machinery space open or while someone is in the machinery space, either closed or open. Never open the machinery space unless the engine is shut off and the engines’ rotating parts are stationary. Rotating machinery can cause injury and even death if an accident should occur. Extreme care must be exercised if a problem exists that requires operation of the engine with the machinery space open. ***IT IS RECOMMENDED THAT UNCOVERED ENGINE OPERATION BE ATTEMPTED BY TRAINED AND QUALIFIED SERVICE PERSONNEL ONLY.***

Transmission Fluid

CAUTION

Crusader Marine Engines uses marine transmissions supplied by several manufacturers. The maintenance requirements can be different between these manufacturers. It is important that you refer to the operation and maintenance manual supplied by the transmission manufacturer before you attempt to perform maintenance on your own. If no maintenance manual is available, Crusader Marine Engines recommends that you contact your dealer's service department for any required maintenance or service instructions.

1. Remove the dipstick by turning the T-handle counterclockwise. Observe the fluid level. Replace the dipstick and tighten securely.

WARNING

Do not attempt to remove the transmission dipstick while the engine is running. Hot transmission fluid could be sprayed from the dipstick hole.

2. Operate the engine until the engine and the transmission reach operating temperature.

3. Stop the engine and quickly check the fluid level to minimize the drain-back from the oil cooler. Remove the dipstick by turning the T-handle counterclockwise. Observe the fluid level.

4. The fluid level should be at the "FULL" or "MAX" mark. If low, add the specified fluid through the dipstick tube. Repeat checking procedures as required until the fluid level is at the "FULL" or "MAX" mark.

5. Replace the dipstick and tighten securely.

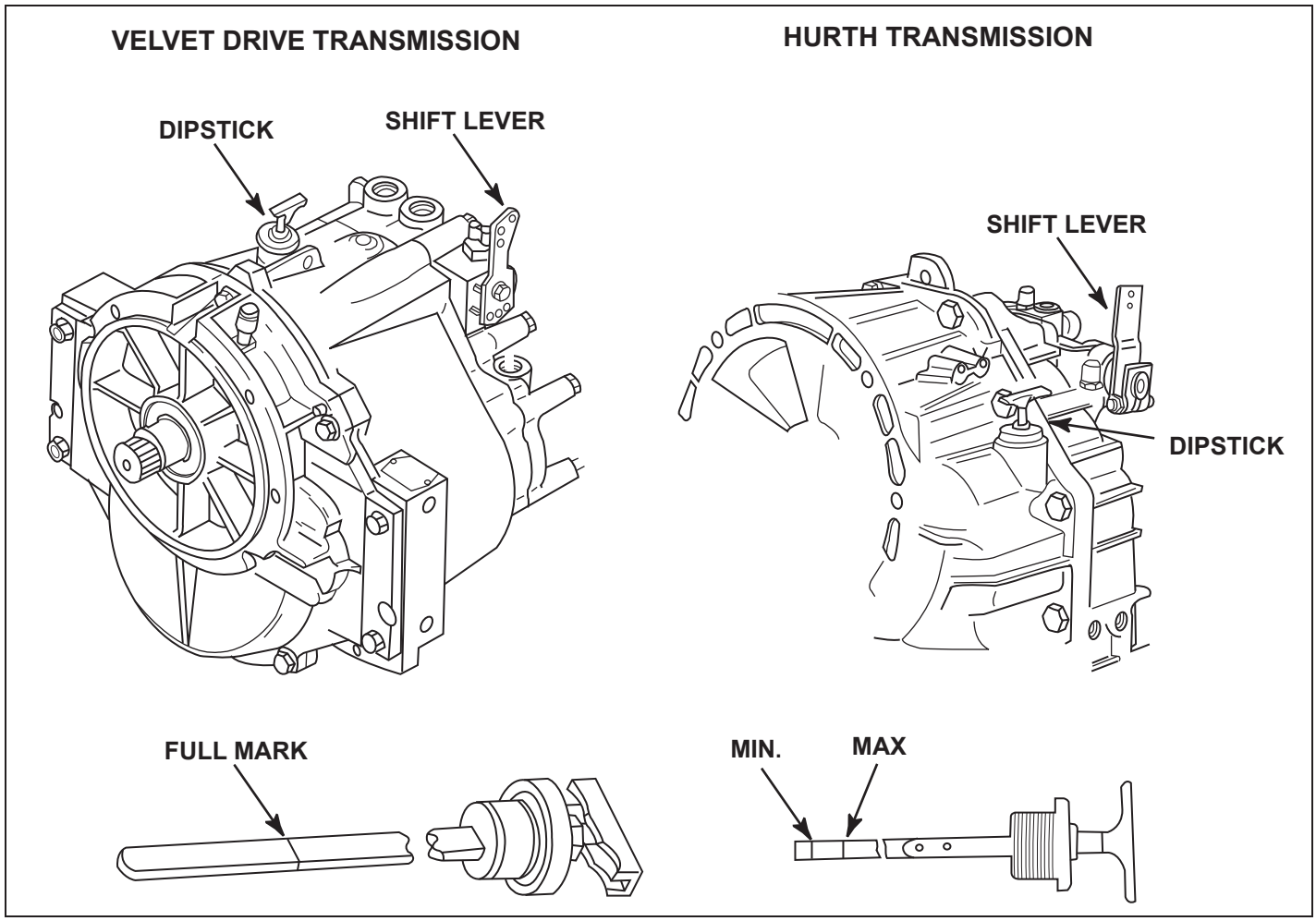


Figure 10-2 Transmission Dipstick and Location

LUBRICATION

Throttle Cable

Lubricate pivot points and exposed cable (Figure 10-3) with SAE 30W-30 engine oil.

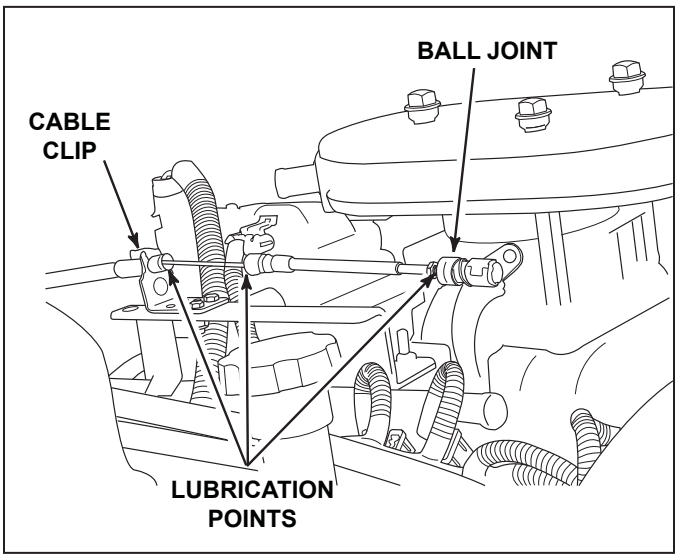


Figure 10-3 Typical Throttle Cable

Shift Lever

All Velvet Drive Transmissions - Lubricate the detent ball and holes in shift lever (Figure 10-4) with white grease (Lubriplate or equivalent).

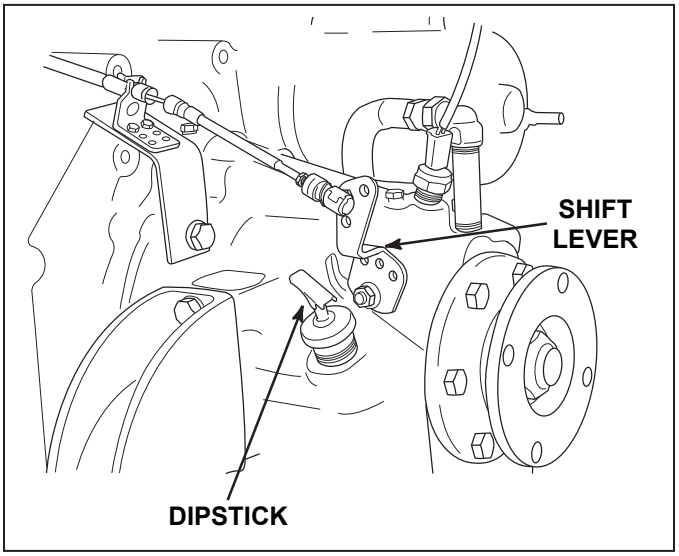


Figure 10-4 Transmission Shift Lever - Velvet Drive 5000

Shift Cable

Lubricate pivot points and exposed cable (Figure 10-5) with SAE 30W-30 engine oil.

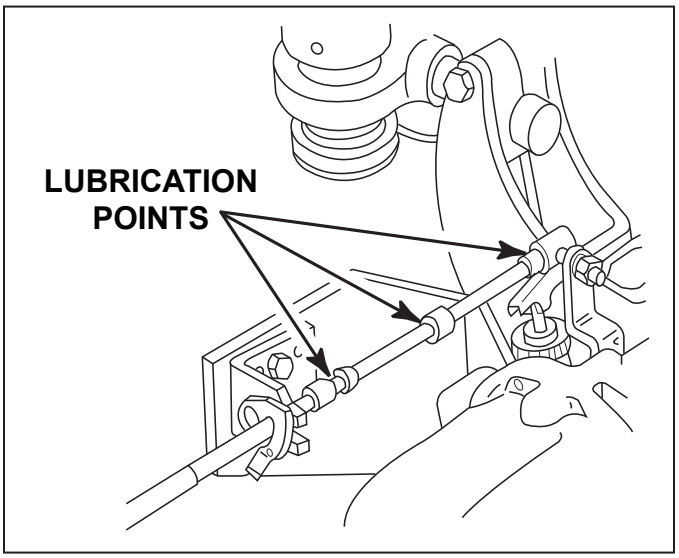


Figure 10-5 Typical Shift Cable

ELECTRICAL SYSTEM CIRCUIT BREAKER

Main Circuit Breaker

Crusader engines are equipped with a circuit breaker which provides electrical overload protection for both engine and instrumentation wiring and components. Should an electrical overload occur, the circuit breaker will open and prevent electrical current flow.

When this circuit breaker opens, the cause for the high current draw must be found and corrected. The circuit breaker can be reset by pushing the “Reset” button IN after waiting a few minutes. If the cause of the overload cannot be found, disconnect all accessories which are connected to the main wire harness.

If resetting is still not possible, check the battery and alternator connections and all other harness connectors on the main harness. Check for loose or disconnected lead wires and shorted circuits.

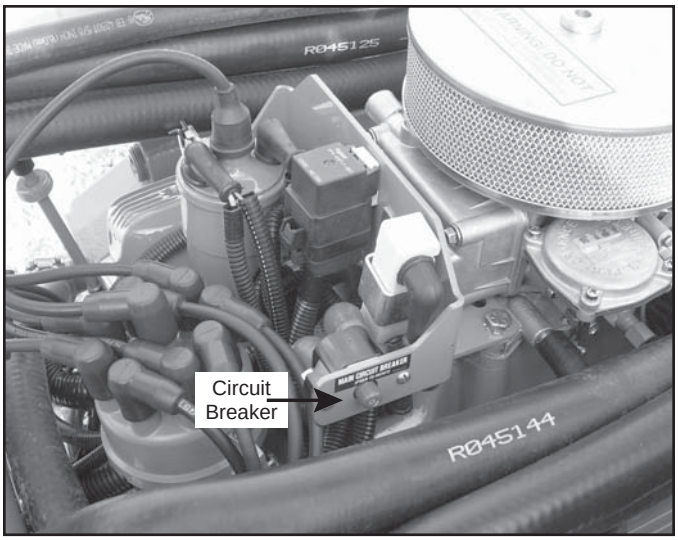


Figure 10-6 Typical Electrical System Circuit Breaker

ELECTRICAL SYSTEM FUSES

Crusader engines utilize a fuse to protect the fuel pump. The fuse is mounted in the main engine harness, in a weather-tight cover, located near the throttle cable bracket.

The fuse is a 5A, slow blow, Buss type fuse. Should this fuse open, the fuel pump will not operate. Check wiring for loose connections and shorted wires. If unable to resume normal fuel pump operation, after replacement of the fuse, it is possible the electric fuel pump has failed internally. Contact your Crusader Premier dealer for proper replacement of the fuel pump.

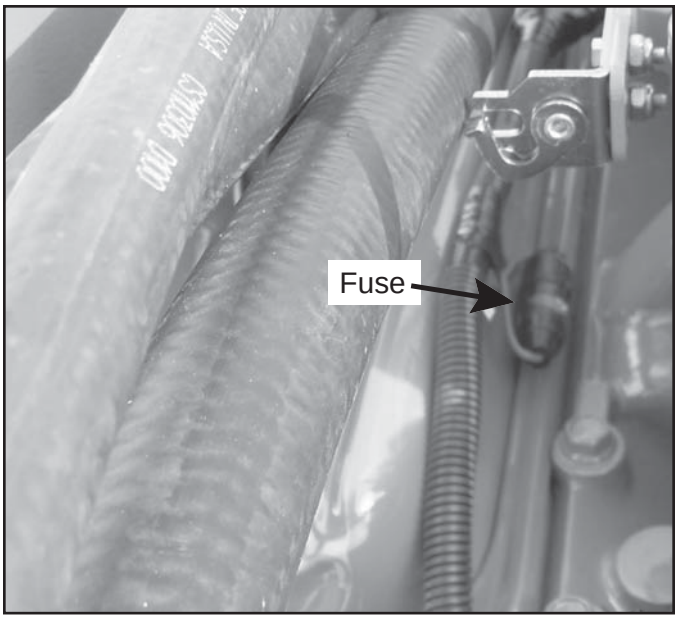


Figure 10-6A Typical Electrical System Fuse

IGNITION FUSE

If the engine will not crank, when the ignition key is turned to the START position, first check that the shift lever is in neutral position. If the main circuit breaker is not tripped, check for blown ignition fuse. The ignition fuse may be located on the instrument panel, the fuse holder block or as part of the instrument wiring harness. Check the wiring diagrams supplied from the boat manufacturer for the exact location.

ELECTRICAL SYSTEM WIRING AND CONNECTORS

WARNING

Always disconnect battery cables from battery when servicing electrical system to prevent personal injury and to prevent damage to electrical system components.

The electrical system wiring and connectors should be checked periodically for loose or dirty connections and damaged wiring. If electrical components or wiring show signs of corrosion, deterioration or damage, consult a Crusader Marine Engines Premier dealer to make necessary repairs.

BATTERY

WARNING

Battery electrolyte is a corrosive acid and should be handled with care. If electrolyte is spilled or splashed on any part of the body, IMMEDIATELY flush the exposed area with liberal amounts of water and obtain medical aid as soon as possible. Safety glasses and rubber gloves are recommended when handling batteries or filling with electrolyte.

WARNING

Hydrogen gases that escape from the battery when charging are highly explosive. Do not use jumper cables and a booster battery to start the engine. Do not recharge a weak battery in the boat. Remove the battery from the boat and recharge in a well ventilated area away from fuel vapors, sparks and open flames.

Follow maintenance instructions and warnings as supplied by the battery manufacturer. If this information is not available, follow these guidelines for the proper battery care.

- Do not operate the engine with an open battery circuit, as this may cause damage to the alternator. Make sure that all connections are clean and secure.
- When removing the battery cables, always remove negative (-) cable first, and then remove the positive (+) cable. When installing battery cables, install the positive (+) cable first, then install the negative (-) cable.
- Periodically check the battery for signs of corrosion, frayed battery leads or cracked case. Repair or replace as necessary.
- Periodically check the electrolyte level. Add distilled water to bring up to the proper levels.

IMPORTANT: Your engine is designed to work with the standard electronics installed in your boat. If you add other electrical components or accessories, you could change the way the fuel injection controls your engine or the overall electrical system functions. Before adding electrical equipment, consult your dealer. If you don't, your engine may not perform properly.

CAUTION

Add-on equipment may adversely affect the alternator output or overload the electrical system. Any damage caused as a result will not be covered by, and may void, your warranty.

FRESH-WATER COOLING SYSTEM SACRIFICIAL ZINC ANODE

Located in the raw water side of the heat exchanger and in the bottom of the oil cooler are zinc anodes which are marked by decals. To check, remove the plug and visually check the condition of the zinc rod. The length of the zinc rod when new is approximately 1.5 inches. If more than one half of the zinc is gone, replace with a new zinc anode.

Different geographic locations and water make-up can result in either high or low sacrificial requirements. A high rate of zinc anode consumption should also alert the owner to a possibility of an improperly wired boat accessory, which would require complete checking by qualified service personnel.

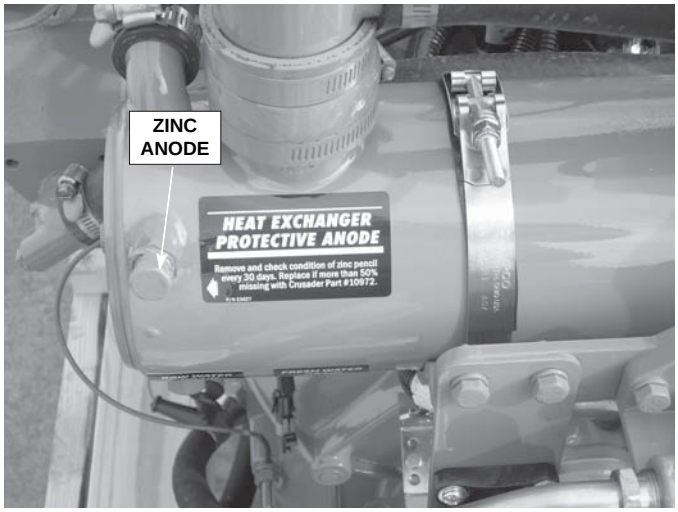

ZINC
ANODE
HEAT EXCHANGER
PROTECTIVE ANODE
Remove and check condition of zinc pencil every 30 days. Replace if more than 50% missing with Crusader Part #10972.

Figure 10-7 Zinc Anode Location F.W.C. Heat Exchanger (Typical)

CHECKING COOLANT LEVEL

WARNING

Do not remove cooling system filler cap when the engine is hot. Allow the engine to cool and then remove the pressure cap slowly, allowing the pressure to vent. Hot coolant, under pressure, may discharge violently and cause severe burns.

DeGas Bottle

The “see-through” degas bottle is connected to the heat exchanger by a small hose. The degas bottle collects coolant that expands with rising temperature, and would otherwise overflow from the system. Coolant level should be at or slightly above the “MAX” mark on the bottle when the system is cold. Coolant should be added ONLY to the bottle when the system cools.

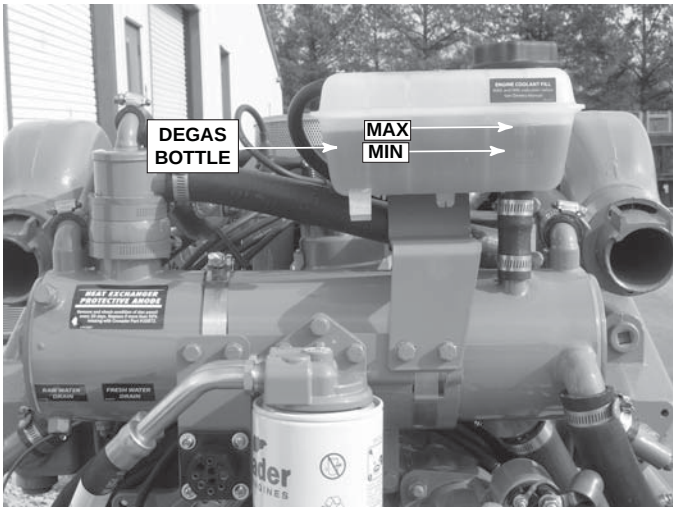


Figure 10-8 Checking Coolant Level (Typical)

FLUSHING COOLING SYSTEM - SEA-WATER SECTION

To prevent silt and/or salt build-up in the cooling system (fresh or raw-water cooled), flush the sea-water section of the cooling system with fresh water at specified intervals.

CAUTION

Do not operate the engine without water being supplied to the sea-water pump. The sea-water pump impeller may be damaged and subsequent overheating damage may result.

CAUTION

Do not run the engine above 1500 RPM when flushing. Suction created by the sea-water pump may collapse the flushing hose, causing the engine to overheat. Watch the temperature gauge while flushing to ensure the engine does not overheat.

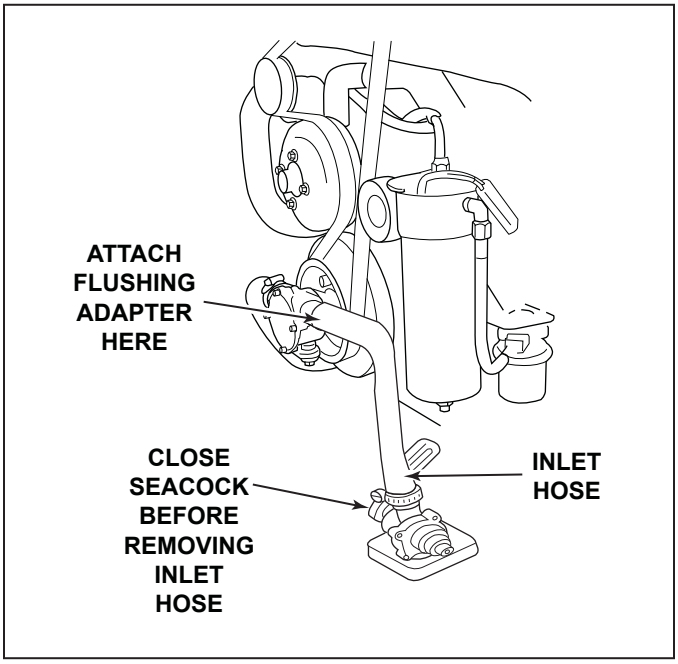


Figure 10-9 Typical Sea-Water Inlet

1. Close sea cock and remove inlet hose at seawater pump.
2. Using an appropriate connector, connect a hose between sea water pump and fresh water tap. Open water tap about ½ of maximum.
3. Start engine and operate at idle speed in neutral for about 10-15 minutes, or until discharge water is clear. Stop engine.
4. Shut off water and remove flushing connector from pump inlet. Reconnect inlet hose, tightening hose clamp securely.
5. Open sea cock prior to restarting engine.

TESTING COOLANT FOR ALKALINITY

It is recommended that the coolant in the fresh-water section be tested each year for alkalinity. Coolant that is not alkaline has lost the effectiveness of its rust inhibitors, which can lead to internal corrosion and cooling system problems. It is recommended to replace the extended life engine coolant, known as DEX-COOL™, in the system every five years to prevent a build-up of harmful chemicals within the fresh-water system.

WARNING

Do not remove cooling system filler cap when the engine is hot. Allow the engine to cool and then remove the pressure cap slowly, allowing the pressure to vent. Hot coolant, under pressure, may discharge violently and cause severe burns.

1. Obtain red litmus paper from a local supplier (drugstore, laboratory, etc..).
2. Remove the pressure cap from the Degas Bottle and insert one end of the litmus paper into the coolant.
3. If red litmus paper turns blue, coolant is alkaline and does not need to be replaced. If the litmus paper remains red, the coolant is not alkaline and must be replaced.

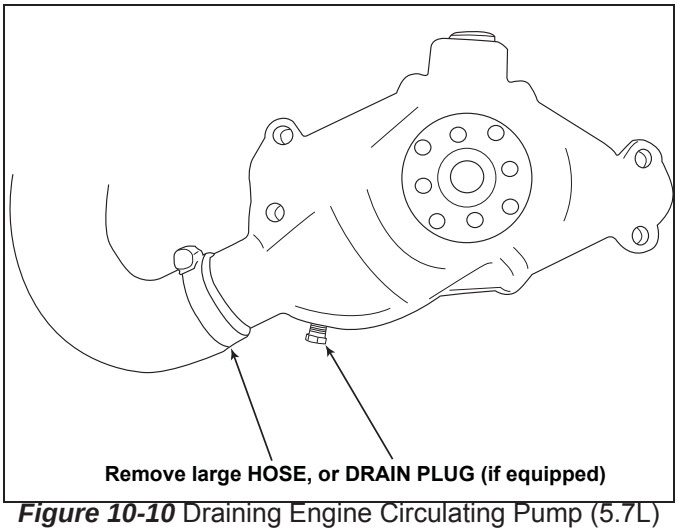


Figure 10-10 Draining Engine Circulating Pump (5.7L)

DRAINING FRESH-WATER COOLING SYSTEM

WARNING

Do not remove cooling system filler cap when the engine is hot. Allow the engine to cool and then remove the pressure cap slowly, allowing the pressure to vent. Hot coolant, under pressure, may discharge violently and cause severe burns.

NOTICE: To protect the environment, dispose of coolant properly. Check your local restrictions for proper disposal instructions of removed coolant.

NOTICE: Refer to cooling system water flow diagrams for drain locations.

1. Remove the following drain plugs to drain coolant from the fresh-water cooling system:
   - Drain plug on heat exchange (center)
   - The hose and/or drain plugs from the fitting on the bottom of the exhaust manifolds (one on each side)
   - Drain plugs from heated risers (two each side, if equipped)
   - Drain plugs on the cylinder block (one on each side)
2. Remove the large hose from the engine block water circulating pump.
3. After system has drained completely, coat all the drain plugs with PerfectSeal (or equivalent) and reinstall in the proper locations. Reinstall the hose(s) on the water circulating pump and the exhaust manifolds and tighten the clamps securely.

FILLING FRESH-WATER COOLING SYSTEM

A new extended life engine coolant known as DEX-COOL™ is used in your engine(s). It is imperative to note the following about DEX-COOL™ engine coolant:

- IT IS PINK IN COLOR TO DISTINGUISH IT FROM CONVENTIONAL COOLANT.
- THE SERVICE CHANGE INTERVAL ON ENGINES BUILT WITH DEX-COOL™ IS 5 YEARS.
- TO MAINTAIN FULL CORROSION PROTECTION DURABILITY, DEX-COOL™ MUST NOT BE MIXED WITH CONVENTIONAL (CONTAINING SILICATE) ENGINE COOLANTS.
- DEX-COOL™ IS AN ETHYLENE GLYCOL BASED PRODUCT, THEREFORE, BOIL AND FREEZE PROTECTION ARE MEASURED IN THE SAME FASHION AS CONVENTIONAL COOLANTS.

TO FULLY REALIZE ITS MANY ADVANTAGES, DEX-COOL™ MUST NEVER BE MIXED WITH CONVENTIONAL COOLANTS.

DEX-COOL™ can become contaminated by inadvertently topping-off with conventional coolant, adding conventional coolant to the system or even if fill/drain containers are shared between coolants. If contamination occurs, the cooling system must be immediately drained and flushed, and refilled with DEX-COOL™. No short-term damage will occur, however, the service interval will be reduced from 5 years to 2 years.

The fresh-water cooling side of the cooling system must be filled with a 50/50 mixture of DEX-COOL™ (or equivalent, which meets GM6277M) extended life antifreeze and water solution.

IMPORTANT: More than 50% antifreeze solution can contribute to an overheating condition.

IMPORTANT: If the engine is being placed in winter storage, the fresh-water cooling section must be filled with the correct type of coolant and water solution, properly mixed, to protect the engine to the lowest temperature to which it will be exposed.

1. Make sure that all drain plugs are properly installed.
2. Remove the pressure cap from the Degas Bottle, located on the heat exchanger.
3. Fill the system with antifreeze solution until the system is filled. See ENGINE FLUID CAPACITIES for system capacities.
4. Start the engine and operate at idle speed (800-1000 RPM) to purge any air from the system. When the coolant level remains constant in the filler riser, install the pressure cap on the riser.
5. Add additional coolant into the Degas Bottle to the “MAX” level.
6. Continue to run the engine until it reaches normal operating temperature. Check the Degas Bottle for the proper level and add coolant if necessary.

NOTICE: It is not necessary to remove pressure cap to check coolant levels. Check Degas Bottle daily and keep filled to the cold, or “MAX”, level indicated on the tank.

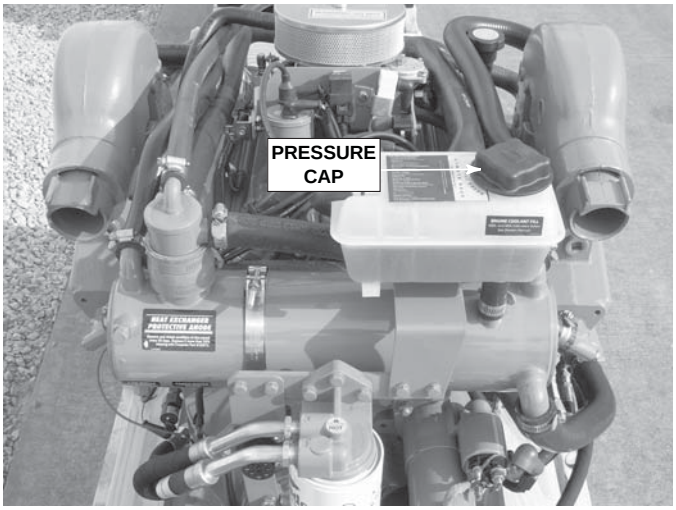


Figure 10-11 F.W.C. Fill Riser Location (Typical)

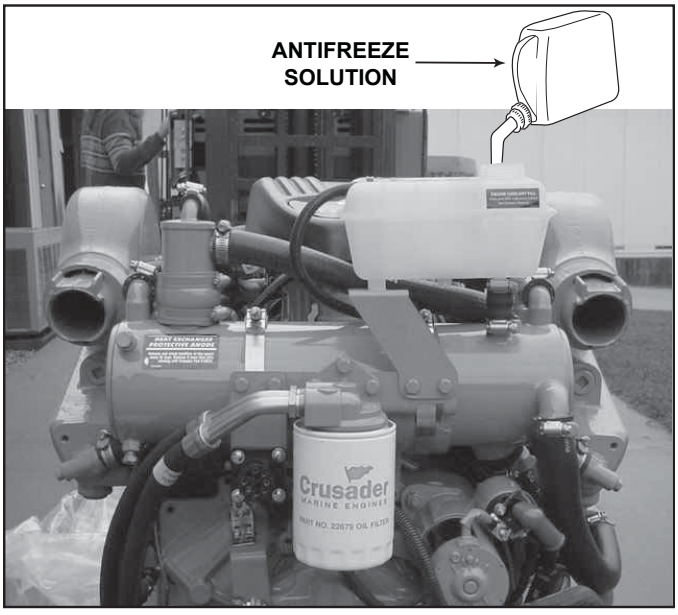


Figure 10-12 Filling F.W.C. System (Typical)

CLEANING SEA-WATER SECTION OF HEAT EXCHANGER - FRESH-WATER COOLED MODELS ONLY

The sea-water section of the heat exchanger should be cleaned whenever there is a noticeable decrease in cooling efficiency. You may use the following procedure for cleaning, or, if the build-up of scale and mineral deposits is heavy, it is recommended that the heat exchanger be removed and taken to a repair facility to be boiled out (such as a radiator repair facility).

1. Remove the bolts securing the heat exchanger end plates. Remove the end plates and gaskets.

2. Clean the water passages in the heat exchanger by inserting a suitable-size wire brush into each passage. Use compressed air to blow out loose particles.

3. Clean the gasket surfaces on the end plates and the heat exchanger. Apply PerfectSeal to both sides of the new gaskets. Install the end plates and the new gaskets onto the heat exchanger. Install the bolts and tighten securely.

4. Start the engine and inspect for leaks.

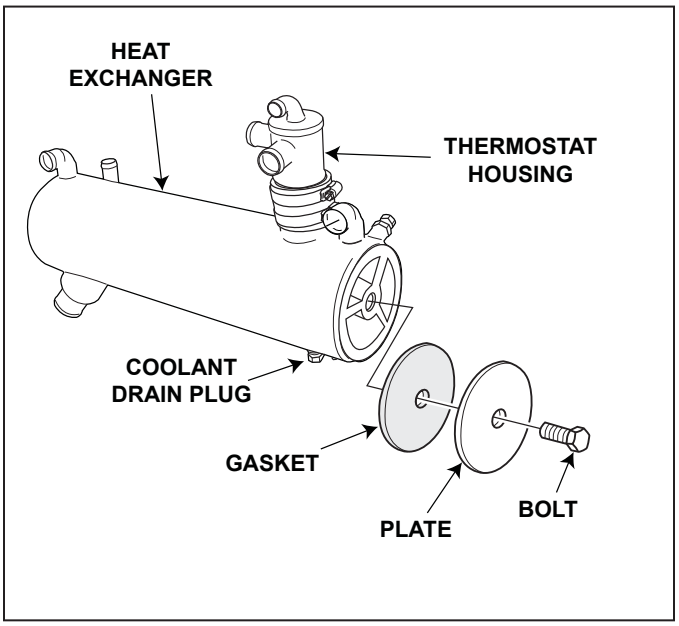


Figure 10-13 Heat Exchanger and End Plate Removal (Typical)

FUEL SYSTEM DESCRIPTION

WARNING

Extreme caution must be exercised when servicing the fuel system and/or replacing fuel filter. Gasoline is extremely flammable and highly explosive under certain conditions. Be sure the ignition key is off and do not smoke or allow open flame in the area while servicing. Wipe up any spilled fuel immediately.

WARNING

Make sure that there are no fuel leaks before closing the engine hatch.

WARNING

Visually inspect unit for fuel leaks before operating the engine. If fuel leaks are present, DO NOT operate the engine, contact your Crusader Premier service center immediately.

ELECTRIC FUEL PUMP

Crusader Marine Engines are equipped with an electric fuel pump mounted on the front right side of the engine, behind the sea water pump and in front of the engine mount. The operation of the pump is controlled by an oil pressure switch located in the main oil pressure galley. Loss of oil pressure will cause the switch to open and halt the flow of electrical power to the fuel pump. The fuel pump circuit is also energized when the starter motor is engaged, so fuel will be available to the carburetor upon engine startup. Once the engine starts and oil pressure is achieved, the pump will continue to operate.

Priming Fuel System

When first starting the engine, or after changing fuel filters, it may be necessary to prime the fuel system. Priming the fuel system may be accomplished by cranking the engine until it starts or 30 seconds elapse. If the engine does not start, wait 2 minutes and repeat the priming procedure.

WARNING

Make sure there are no fuel leaks before closing the engine hatch.

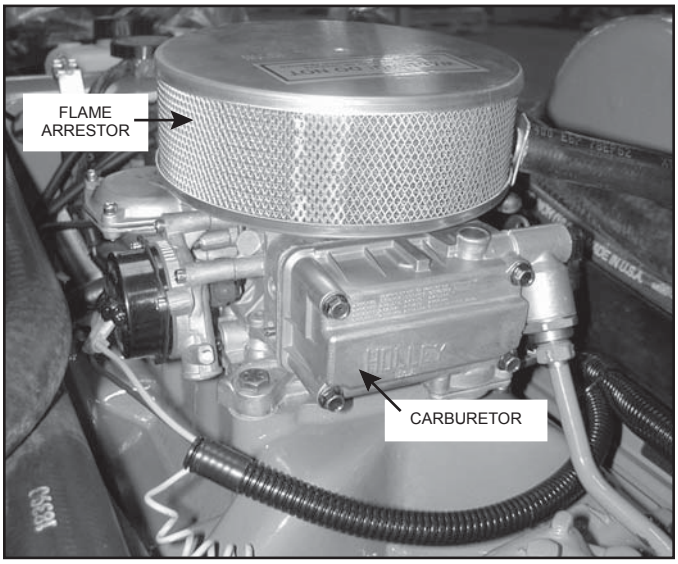


Figure 10-14 Flame Arrestor - 5.7L (Typical)

FLAME ARRESTOR

At specified intervals, the flame arrestor should be checked for blockage caused by dirt or other foreign material.

Loosen the screw(s) securing the flame arrestor cover and flame arrestor to the carburetor. Remove the flame arrestor and crankcase vent hose(s). Clean the flame arrestor with solvent and dry with compressed air. Reinstall the flame arrestor and cover then tighten the retaining screw(s) securely.

WARNING

Engine must be shut OFF and the ignition key removed before inspecting the drive belt(s). The drive belt(s) should be checked periodically for condition and tension. If the belt(s) shows signs of cracking, glazing or deterioration, replace with new belt(s).

DRIVE BELT INSPECTION

Inspect the drive belt for excessive wear, shredding or missing sections.

Inspect the drive belt for contamination from excessive dirt, oil, coolant or other substances that may effect the drive belt operation.

If a problem is found, replace the belt after inspecting the following items:

- All pulleys and tensioners for signs of misalignment
- All pulleys and tensioners for signs of rust or other damage
- Bent pulleys or tight bearings in the engine water circulation pump, sea-water pump and alternator

5.7L ACCESSORY DRIVE BELT

The Crusader 5.7L engine uses a single serpentine belt to drive the engine water circulation pump, sea-water pump and the alternator.

Serpentine Belt (LH Rotation) P/N - R066028

Serpentine Belt (RH Rotation) P/N - R066029A

DRIVE BELT REPLACEMENT (5.7L)

1. Note the routing of the belt before removing.
2. Using a 15 mm box wrench or socket, turn the belt tensioner to relieve the tension on the belt. Slide the belt off of the pulleys. ***Release the tensioner slowly to prevent the tensioner from snapping against its stop, and possibly causing damage to the tensioner.***
3. Slide the new belt onto the pulleys using the same routing as noted prior to removal.
4. Compress the belt tensioner, and slide the belt over the tensioner pulley. Release the tension slowly to tension the belt.

SERVICING RAW WATER PUMP IMPELLER (5.7L)

The raw water pump impeller should be serviced every 50 hours, or once a year, whichever occurs first. See Maintenance Schedule.

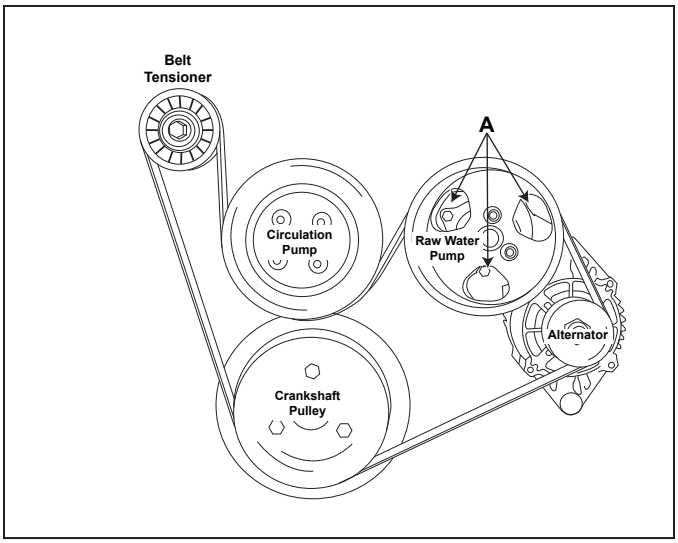


Figure 10-15 5.7L Accessory Drive Belt Configuration (Left Hand Rotation)

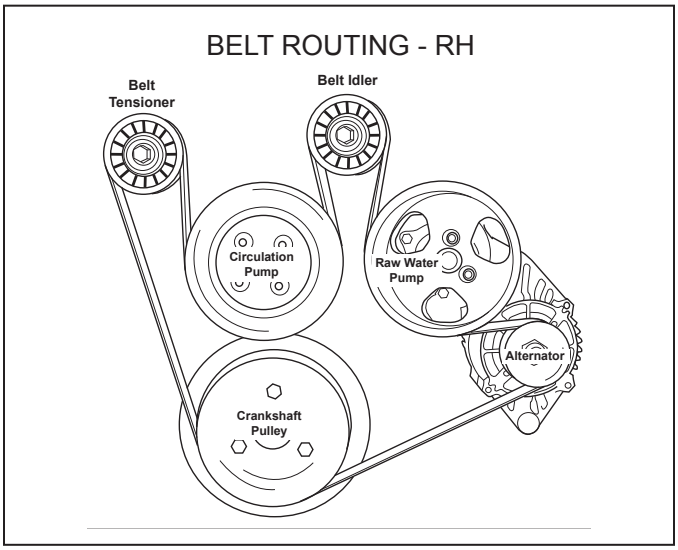


Figure 10-15A 5.7L Accessory Drive Belt Configuration (Right Hand Rotation)

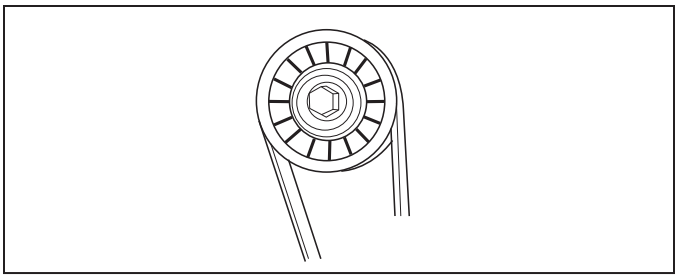


Figure 10-16 Belt Tensioner (5.7L)

Locations “A” (Figure 10-15) are access holes in order to loosen the raw water pump attaching bolts. The bolts are secured in the pump by O-rings, and will not fall out during removal.

Torque the raw water pump housing attaching bolts to 8.5-9 ft.lbs. (11.5-12 N-M), when re-installing the impeller.

CHANGING OILS

WARNING

IMPORTANT: The Federal Water Pollution Control Act prohibits the discharge of oil or oily waste into or upon the navigable waters and continuous zone of the United States, if such discharge causes a film or sheen upon, or discoloration of the surface of the water, or causes sludge or emulsion beneath the surface of the water. Violators are subject to a penalty of $5,000.00.

Refer to the MAINTENANCE SCHEDULE for oil change intervals. The engine and transmission oils should be changed prior to placing the boat into storage.

The transmission oil change should be performed by an authorized dealer, at specified intervals.

IMPORTANT: Change the engine oil when the engine is warm from operation. Warm oil flows more freely, and allows more foreign material and impurities to be removed.

1. With the engine at normal operating temperature, remove the dipstick and install a crankcase oil pump onto the dipstick tube (Figure 10-17). Insert the discharge hose into a suitable container. Pump the oil from the engine until the crankcase is empty. Remove the oil pump from the dipstick tube.

2. Remove the oil filter by turning it counterclockwise, using an oil filter wrench if necessary. Discard the old filter and sealing ring.

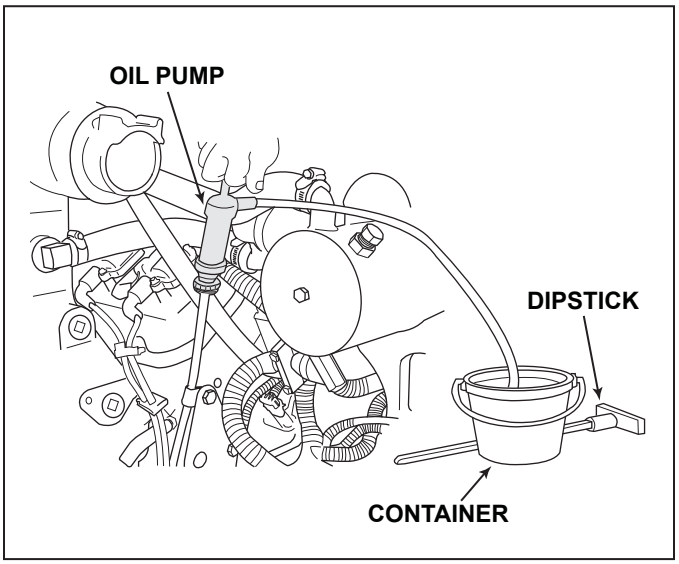


Figure 10-17 Engine Oil Removal

3. Coat the sealing ring, on the new filter, with a light coating of clean engine oil. Install the oil filter securely by hand. DO NOT overtighten.

4. Fill the engine with the recommended oil, see OIL REQUIREMENTS, through the oil fill location on the valve cover (Figure 10-18).

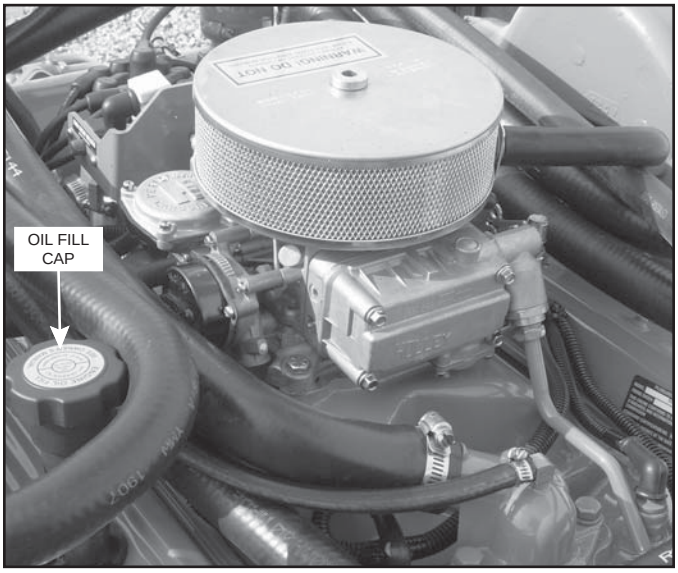


Figure 10-18 Engine Oil Fill (Typical)

5. Start the engine and operate for 5 minutes to circulate the oil throughout the engine. Check entire system for leaks, especially around the oil filter.

6. Stop the engine and wait 5 minutes to allow the oil to completely drain down. Check the oil level and add oil, if needed, to bring the engine oil to the proper level.

ENGINE ALIGNMENT

CAUTION

Engine must be properly aligned, or vibration, noise and damage to the transmission output shaft, oil seal and bearings may result.

IMPORTANT: On boats with remote “V” -Drives, refer to the “V”-Drive manufacturer’s instructions for the correct alignment of the drive shaft between the “V” -Drive and the transmission.

IMPORTANT: Engine alignment MUST BE RECHECKED with the boat in the water, fuel tanks full and with a normal load on the boat.

Engine must be aligned so that the transmission and the propeller shaft coupling center lines are aligned, and coupling faces are parallel within 0.003 in. (0.07 mm). This applies to installations with solid couplings, as well as flexible couplings.

1. Check the mating surfaces on the transmission and the propeller shaft couplings. Make sure they are clean and flat. (Figures 10-19, 10-20)

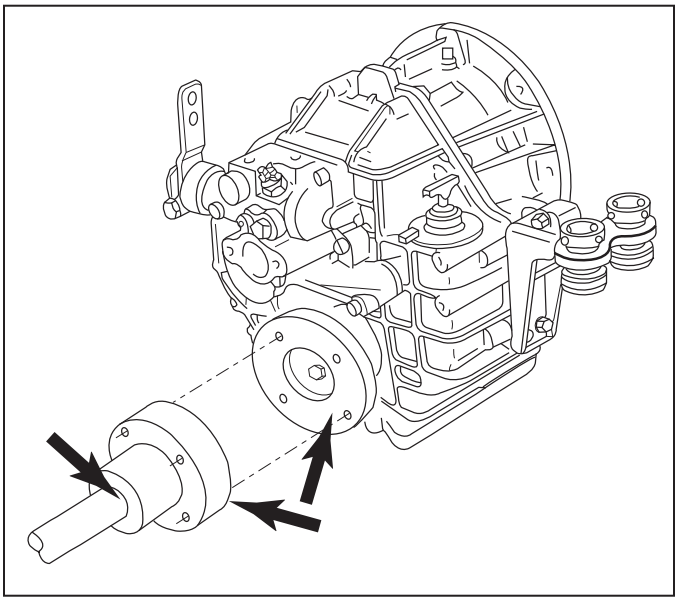


Figure 10-19 Shaft Mating Surface Check - 8 Degree Down Angle

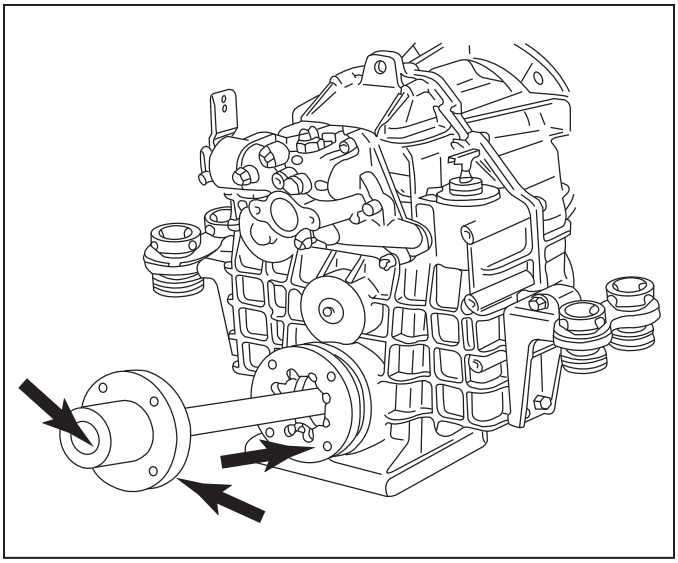


Figure 10-20 Shaft Mating Surface Check - “V” Drives

2. Center the propeller shaft in the shaft log as follows (Figure 10-21):
   - Push down and then lift the propeller shaft as far as it will move, then place the shaft in the middle of the movement.
   - Move the shaft to the port and then to the starboard as far as the shaft will move, then place the shaft in the middle of the movement.
   - With the propeller shaft in the middle of the shaft log, align the engine to the shaft.
3. Check that the coupling center lines align by butting the propeller shaft coupling against the transmission coupling (Figure 10-22). The shoulder on the propeller shaft coupling face should engage the recess on the transmission coupling face, with no resistance.

IMPORTANT: Offset misalignment conditions must be corrected prior to checking for angular misalignment.

NOTICE: Some propeller shaft couplings may not have a shoulder on the mating surface. On these installations, use a straight edge to check the center line alignment. (Figure 10-23)

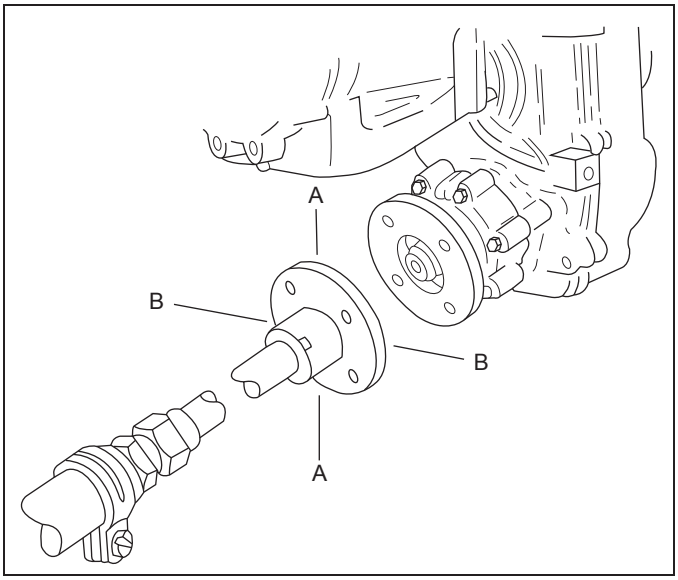


Figure 10-21 Centering Prop Shaft

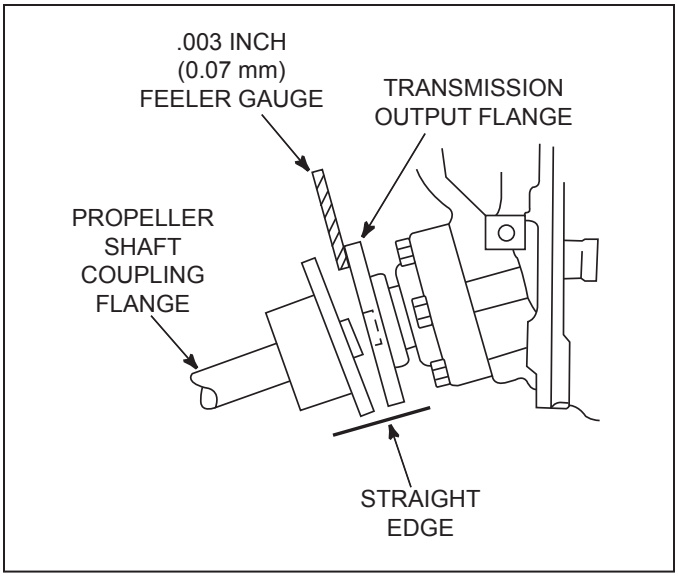


Figure 10-22 Angular Alignment

4. **OFFSET ALIGNMENT:** If the coupling center lines are not aligned, adjust the engine mounts as follows:

    - UP or DOWN OFFSET ADJUSTMENT: Loosen the lag bolt 1/4 turn. Use the mount adjusting tool or a 3/8 in. (0.95 cm) or ½ (1.27 cm) diameter rod through both sides of the adjusting sleeve to turn (Figure 10-24). Turn the adjusting sleeve in the direction required to raise or lower the engine. After the adjustment is complete, tighten the lag bolt.

IMPORTANT: Both front mount (or rear mount) adjusting sleeves must be turned equally to keep the engine level from side to side.

    - LEFT or RIGHT OFFSET ADJUSTMENT: Loosen the trunnion clamping bolt and the nut on all four mounting brackets. Move the engine to the left or right, as necessary, to obtain the proper alignment. (Figure 10-25) After adjustment is complete, tighten all trunnion bolts.

IMPORTANT: The large diameter of the mount trunnion MUST NOT extend over 1.0 in. (25.4 mm) from the mounting brackets on any of the mounts.

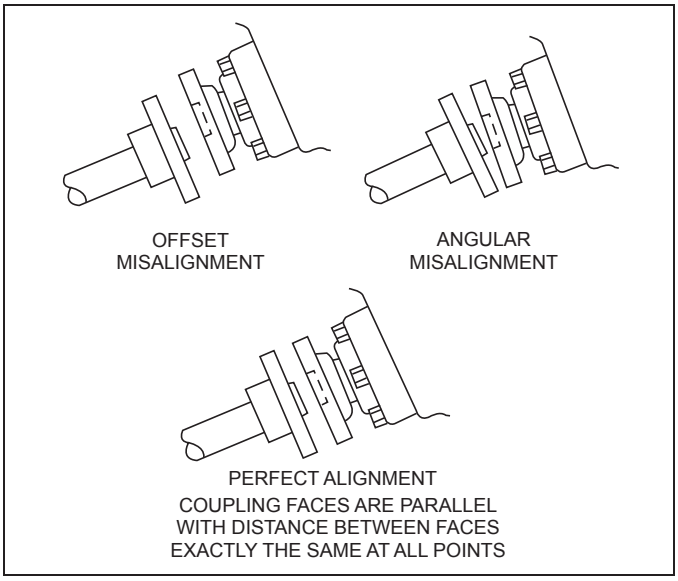


Figure 10-23 Shaft Mating Surface Check

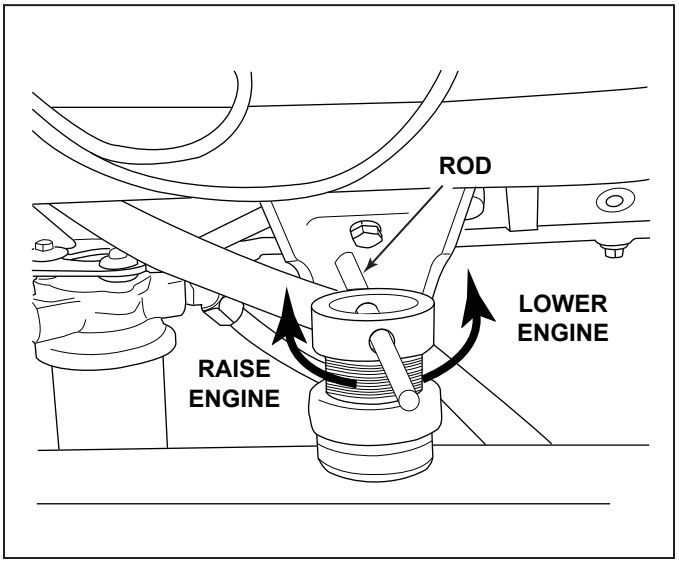


Figure 10-24 Engine Mount Adjustment

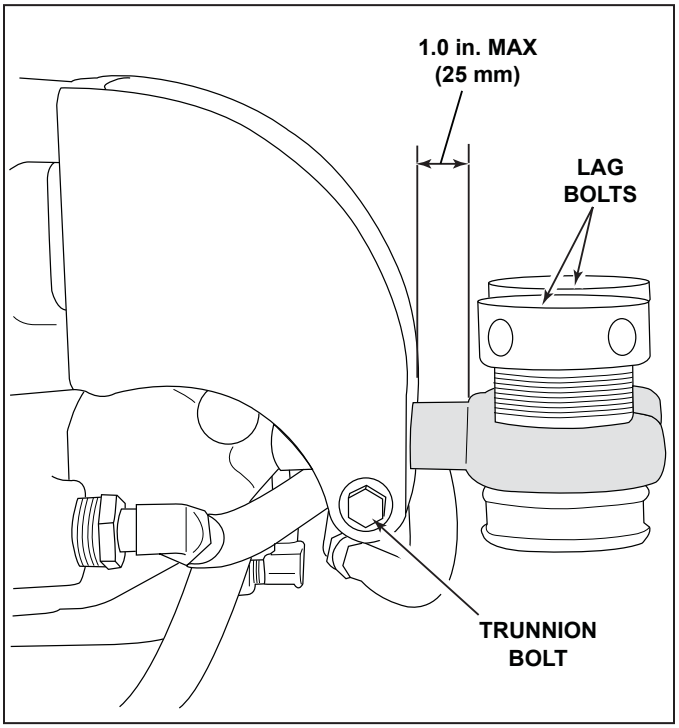


Figure 10-25 Engine Extension

5. Check for angular misalignment (Figure 10-22). Hold coupling faces tightly together, by hand, and check for a gap between the coupling faces, with a 0.003 in. (0.07 mm) feeler gauge, at 90-degree intervals (Figure 10-25).

IMPORTANT: Angular misalignment conditions may require adjustment of one front mount, both front mounts, trunnions, or any combination. Figure 10-26, Angular Alignment Check, and the following table will assist in the alignment process.

ANGULAR MISALIGNMENT	MOUNT ADJUST
"A" Quadrant	Both Front Mounts
"B" Quadrant	Trunnion Adjustment
"LC" Quadrant	Right Front Mount
"RC" Quadrant	Left Front Mount

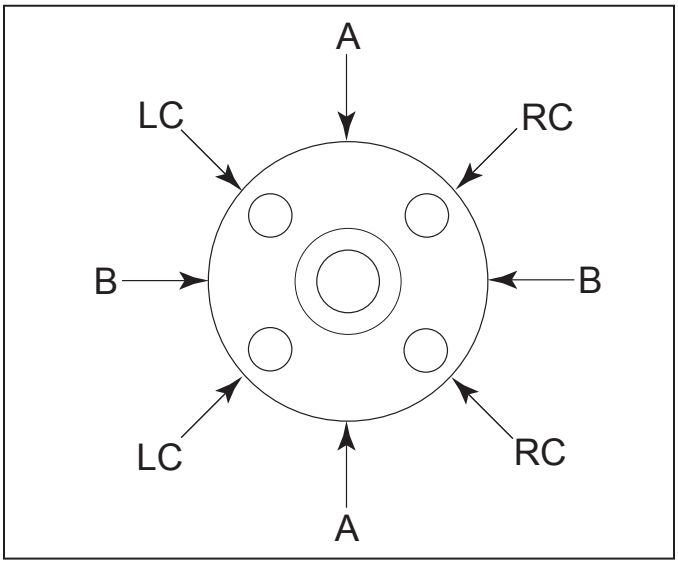


Figure 10-26 Angular Alignment Check

- UP or DOWN ANGULAR ADJUSTMENT: Loosen the lag bolt 1/4 turn. Use the mount adjusting tool or a 3/8 in. (0.95 cm) or ½" (1.27 cm) diameter rod through both sides of the adjusting sleeve to turn (Figure 10-24). Turn the adjusting sleeve in the direction required to raise or lower the engine. After the adjustment is complete, tighten the lag bolt.

- LEFT or RIGHT ANGULAR ADJUSTMENT: Loosen the trunnion clamping bolt and the nut on all four mounting brackets. Move the engine to the left or right, as necessary, to obtain the proper alignment. (Figure 10-25) After adjustment is complete, tighten all trunnion bolts.

6. After the engine has been properly aligned, secure the engine mounts.

7. Connect the propeller shaft coupling to the transmission coupling. Tighten the coupling attaching bolts and nuts to the correct specifications.

FASTENER TORQUE SPECIFICATIONS

Location	Lb-Ft (N·m)
Engine Mount to Stringer	Securely
Propeller	50 (68)
Trunnion Bolts	45 (61)

ENGINE MAINTENANCE - 10

Date	ENGINE MAINTENANCE LOG Maintenance/Repair	Operating Hours

MAINTENANCE SCHEDULE

Location and Service	Check Daily	After 1st 25 Hrs of Operation	Every 50 Hours of Operation	Every 100 Hours of Operation	Once Each Year
Check coolant level - Fresh-water cooled models only	X				
Check oil level - Engine crankcase	X				
Check oil level - Transmission	X				
Engine Assembly (complete - Check for obvious leaks (water, oil, fuel and exhaust)	X				
Remote Control and Steering System - Check for proper operation	X				
Sea Strainer - Check (if equipped)	X				
Cooling System - Check condition and tightness of all hose clamps		X		X[1]	X
Cooling System - Inspect/Replace raw water pump impeller			X		X
Drive Belt - Inspect condition and check tension		X		X	X
Exhaust System - Check condition and tightness of all hose clamps		X		X[1]	X
Exhaust System - Check for water leaks at the manifold, riser and elbow gaskets	X				
Ignition System and Spark Plugs - Clean and inspect condition		O		O[1]	O
Engine Assembly (complete) - Check for loose, missing or damaged parts (especially engine mounts, starter and alternator mounting fasteners)		X		X	X
Change engine oil and filter		X	X		X
Engine Alignment - Check and adjust if necessary		O			O
Ignition Timing - Check and adjust if necessary		O			O
Battery - Check electrolyte level and specific gravity. Inspect case for damage. Check cables and connections.		X	X		X
Electrical System (complete) - Check for loose or dirty connections and damaged wiring			X[2]		X
Flame Arrestor and Crankcase Ventilation System - Clean and inspect				X	X

MAINTENANCE SCHEDULE (cont'd)

Location and Service	Check Daily	After 1st 25 Hrs of Operation	Every 50 Hours of Operation	Every 100 Hours of Operation	Once Each Year
Hoses (all) - Inspect for cracks, swelling, weather checking or other signs of deterioration				X	X
Shift and Throttle Cable Linkage - Inspect and lubricate (A)				X[1]	X
Fuel Filters - Service or replace		O		O	O
Transmission and "V" Drive - Change fluid (B,C) and clean strainer, if equipped		O Hurth Only			O

MAINTENANCE SCHEDULE (cont'd)

Carburetor - Adjust	As required (O)
Fresh-water cooled models - Clean sea-water section	As required [3] (X)
Fresh-water cooled models - Check coolant for alkalinity	At least once each year (X)
Fresh-water cooled models - Change coolant	Every five years
Zinc Anodes - Heat exchanger and cooler - check condition	Every 30 days [3] (X)
Engine Assembly Exterior Surfaces - spray with rust-preventative oil (D)	Fresh water areas - Every 60 days (X) Salt water areas - Every 30 days (X)
Cooling System (SALT WATER AREAS ONLY) - Flush sea-water section	After use each day (X)

Notes:

(X) Denotes service to be performed by the owner/ operator

(O) Denotes service to be performed by an authorized Crusader Marine Engines dealer

(A) Use SAE 30 engine oil

(B) All Velvet Drive and Hurth transmissions - Use Dexron III automatic transmission fluid

(C) All Velvet "V" Drive transmissions - Use Dexron III automatic transmission fluid

All Walters "V" Drive transmissions - Use Exxon Spartan EP-68 or SAE 30 engine oil

All Crusader "V" Drive transmissions - Use SAE 80W-90 gear oil

(D) Use WD-40 penetration oil or equivalent

[1] In fresh-water areas, every 100 hours of operation or 120 days (whichever occurs first). In salt-water areas, every 50 hours of operation or 60 days (whichever occurs first).

[2] In fresh-water areas, every 50 hours of operation or 60 days (whichever occurs first). In salt-water areas, every 25 hours of operation or 30 days (whichever occurs first).

[3] Requires more frequent inspection if used in extremely salty, polluted or mineral-laden waters.

VISUAL INSPECTION

It is important for the owner/operator to visually inspect the complete engine assembly at regular intervals. Most often, costly repairs can be avoided if potential problems are corrected before there is a failure.

Inspect the complete engine assembly for obvious fuel, oil, water or exhaust leaks. Check for loose, damaged or missing parts. Check all hose clamps for adequate tightness. Check the electrical system for loose or dirty connections or damaged wiring.

Touch up scratches, nicks and corrosion damage to the exterior finish of the engine. Spray paint may be obtained from your local Crusader Marine Engines Premier dealer.

Protect engine finish from corrosion by periodically spraying the engine exterior finish with a rust preventative oil (such as WD-40).

ENGINE FLUID CAPACITIES

Model	**5.7L**
Crankcase Oil Capacity **W / New Filter** Aluminum Pan Stamped Steel Pan	 6 Quarts (4.73 - 6.62 L)[1] 4.75 Quarts (4.5 L)[1]
Fresh Water Cooling System Capacity	23 Quarts (231.77 L)

TRANSMISSION FLUID CAPACITIES

Model	**All Models**	**Type**
Velvet Drive, 1:1 Ratio [1,2]	2.5 Quarts (2.37 L)	DEXRON III
Velvet Drive, 1:52 - 2.91:1 Ratio [1,2]	3.5 Quarts (3.31 L)	DEXRON III
Velvet Drive, V-Drive (exc. 5000), All Ratios [1,2]	4.5 Quarts (4.26 L)	DEXRON III
Velvet Drive 5000 (exc. V-Drive), All Ratios [1,2]	3.0 Quarts (2.37 L)	DEXRON III
Velvet Drive 5000 V-Drive, All Ratios [1,2]	4.5 - 5.0 Quarts (4.26 - 4.73 L)	DEXRON III
Hurth (exc. V-Drive), All Ratios [1,2]	4.0 Quarts (3.79 L)	DEXRON III
Hurth V-Drive, All Ratios [1,2]	4.5 - 5.0 Quarts (4.26 - 4.73 L)	DEXRON III
Walters RV-36D V-Drive	1.5 Quarts (1.42 L)	SAE 30

1 - Capacities are dependent on installation angle. ALWAYS use the dipstick to determine the exact quantity of oil required. Add the correct amount of oil to fill to the “FULL” mark on the oil level dipstick.

2 - Check the transmission fluid level at operating temperature and immediately after shutdown of the engine.

FILTER REQUIREMENTS

Description	Part No.
Oil Filter (remote-mounted)	22679
Kit, Transmission Oil Filter (ZF)	RP077011
Water Separator/Fuel Filter	See Dealer

ON-BOARD PARTS KITS

Description	Part No.
ON-BOARD PARTS KIT 5.7L (LH) '04 SERPENTINE	**RK173094**
Box, On-Board	22433
Belt, Serpentine	R066028
Coil, Ignition Breakerless	R117004
Resistor, Ignition	R119001
Relay, Starter	R130011A
SparkPlug, Set, (Platinum)	RP030010
Impeller, Raw Water Pump	RP061022
Module, Ignition	RP116022
Tune-Up Kit, Cap and Rotor	RP173081A
ON-BOARD PARTS KIT 5.7L (RH) '04 SERPENTINE	**RK173094A**
Box, On-Board	22433
Belt, Serpentine	R066029A
Coil, Ignition Breakerless	R117004
Resistor, Ignition	R119001
Relay, Starter	R130011A
SparkPlug, Set, (Platinum)	RP030010
Impeller, Raw Water Pump	RP061022
Module, Ignition	RP116022
Tune-Up Kit, Cap and Rotor	RP173081A

ENGINE SPECIFICATIONS

MODEL (Horsepower)	5.7L (300 HP - Carburetor)
Displacement	5.7L (350 CID)
Bore	4.0 in. (101.6 mm)
Stroke	3.48 in. (88.3 mm)
Compression Ratio	9.4:1
Compression Pressure	130 - 215 psi (896 - 1482 kPa)
WOT Operating RPM	4800 - 5200
Cruising RPM (Max)	4000
Idle RPM (In Gear)	650 - 750
Ignition Timing	26° BTDC @ 4000 RPM
Oil Pressure @ 2000 RPM	25 - 60 psi (172 - 414 kPa)
Minimum Oil Pressure	10 psi (69 kPa) at Idle
Fuel Pressure	4-7 psi (28-48 kPa)
Thermostat	RWC 160˚F (61.7˚C) FWC 170˚F (76.7˚C)
Over-Temp Sense	210° F (100° C)
Electrical System	12 Volt Negative (-) Ground
Alternator Rating	70 Amps
Battery Rating	650 CCA (Minimum) 120 Ah

IMPORTANT: FUEL PRESSURE MEASUREMENT MUST BE MADE WITH THE ENGINE UNDER LOAD @ WOT.

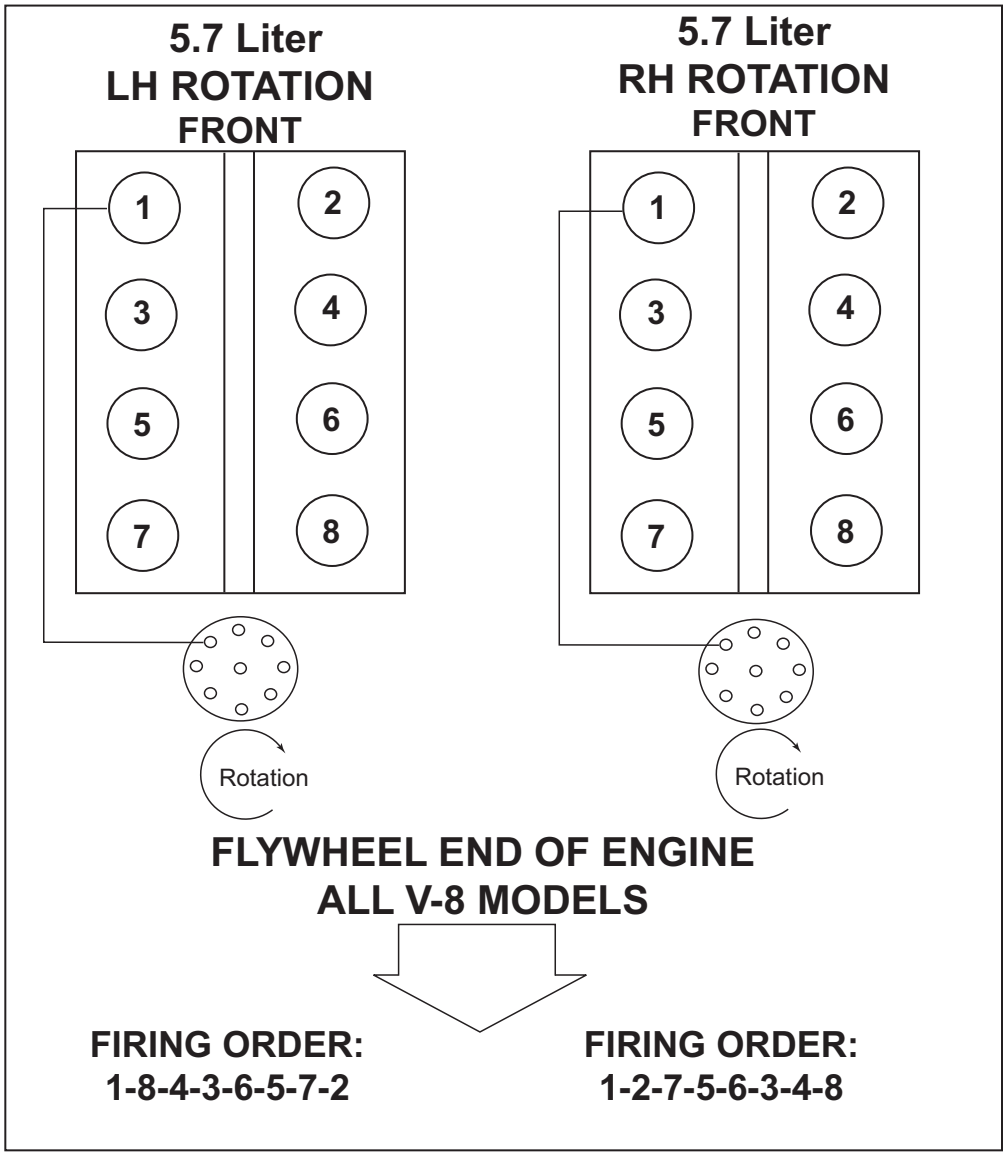


Figure 11-1 V-8 Firing Orders

TUNE-UP SPECIFICATIONS

Model	**5.7L (300 HP)**
Spark Plug Type	P/N - R030010
Spark Plug Gap	0.045 in. (1.14 mm)
Timing @ 4000 RPM	26° BTDC
Carburetor Idle Mixture	1-2 turns
Firing Order	1-8-4-3-6-5-7-2 (LH Rotation) 1-2-7-5-6-3-4-8 (RH Rotation)

ENGINE STORAGE

IMPORTANT: This service should be performed by an Authorized Crusader Premier Dealer.

CAUTION

Refer to FLUSHING COOLING SYSTEM before proceeding.

1. Fill the fuel tanks with gasoline and add a sufficient amount of gasoline stabilizer, such as STA-BIL™ fuel stabilizer, to prevent the formation of fuel gum and varnish. Follow the instructions on the container.

WARNING

On fuel injected engines, you MUST bleed off fuel pressure before proceeding. Failure to do so may cause personal injury.

2. Remove, empty and clean the fuel filter assembly. Reinstall with a new fuel filter and gasket/seal. Refer to Engine Maintenance for filter replacement procedures.

NOTE: DO NOT re-use old fuel filter components. Always replace with new fuel filter and gasket/seal.

WARNING

Accumulation of water and other fuel contaminants may form corrosive compounds that can damage the fuel filter, and result in fuel leakage. Ethanol blended fuel may increase this risk. For this reason, annual replacement of the fuel filter, at a minimum, is required to avoid risk of explosion or fire.

WARNING

Operate the bilge blower and be sure no fuel vapors are present when treating the engine. Be sure the engine compartment is well-ventilated to prevent a potential fire hazard.

3. Run the engine and allow it to reach normal operating temperature (a minimum of 10 minutes). Shut down the engine and change the oil and oil filter (See ENGINE MAINTENANCE).
4. Flush the cooling system if operating in salt water or brackish water areas. (See ENGINE MAINTENANCE).

NOTICE: The fresh-water cooling system must be serviced before fogging the engine for storage.

WARNING

Operate the bilge blower and be sure no fuel vapors are present when treating the engine. Be sure the engine compartment is well-ventilated to prevent a potential fire hazard.

5. Remove the flame arrestor and start the engine. Operate the engine at a fast idle speed (1000-1500 RPM). Use an aerosol-type fogging solution and spray sufficient amount, into the carburetor bores, to treat internal surfaces of the engine. Refer to the instructions on the fogging solution canister. Turn the ignition switch to the OFF position.
6. Clean the flame arrestor and the vent hoses, and reinstall on the engine. Cover the carburetor ,to prevent the possibility of the water entering the engine through the carburetor, during storage.
7. Close the fuel shut-off valve (if equipped).

DRAINING INSTRUCTIONS

CAUTION

If the boat is to remain in the water during or after draining, close the seacock to prevent a siphoning action that may occur, allowing sea water to flow from drain holes or removed hoses.

IMPORTANT: When removing the drain plugs, insert a wire into the hole to remove any obstruction which would prevent water from draining completely.

FRESH-WATER COOLED MODELS

IMPORTANT: The fresh-water section of the cooling system must be kept filled year around with recommended coolant. Make certain that the cooling system is protected with an ethylene glycol antifreeze mixture properly mixed to protect the engine to the lowest temperature that it will be exposed to.

See the ENGINE MAINTENANCE section for testing alkalinity, draining and refilling procedures of the Fresh Water Cooling System, as required.

IMPORTANT: Drain the sea-water section of the cooling system only.

1. Remove all the drain plugs from the following locations:
   - Heat Exchanger - one on outboard side
   - Exhaust Elbows - two on each side
   - Transmission and Engine Cooler - one drain plug
   - Fuel Cooler Canister (Returnless Fuel System Only) - one drain plug
2. Remove the hose from the inlet side of the sea-water pump.
3. Remove the hose from the outlet side of the sea-water pump.

NOTICE: It may be necessary to bend or lift the hoses to allow water to drain completely.

4. Remove the raw water pump impeller. (See ENGINE MAINTENANCE) If inspection proves the impeller to be in good condition, store it in an accessible spot for re-installation at the end of the storage period. A damaged or badly worn impeller should be discarded and a new one installed at the end of the storage period.

NOTE: Removal of the impeller during storage will prevent the impeller vanes from drying and taking a permanent “set”.

5. After the water has completely drained, coat the threads of drain plugs with PerfectSeal (or equivalent), and reinstall in the proper locations. Reinstall the hoses and tighten all the clamps securely.
6. Loosen the engine alternator and raw water pump drive belt(s).

After draining is completed, perform the additional required maintenance as outlined in the MAINTENANCE SCHEDULE under ONCE EACH YEAR.

BATTERY STORAGE

Follow the battery manufacturer’s instructions for storage. If not available, use the following instructions:

- Remove the battery from the boat and clean, removing dirt and grease from the top of the battery.
- Fill the battery with distilled water to the manufacturer’s specifications.
- Store the battery in a cool, dry place. Do not store on a concrete surface.
- Periodically (every 30 to 45 days), check the water level and recharge the battery to the manufacturer’s specifications. Do not fast charge.

CAUTION

A discharged battery can be damaged by freezing.

OUT-OF-SEASON ENGINE WARM-UP

If it is necessary to start your engine(s) during cold weather storage, refer to the following procedure.

1. Refer to “Recommissioning After Storage” to make certain all drain plugs, hoses, batteries and connections are secure.
2. Start the engine(s) and idle until normal engine oil pressure is reached.
3. Raise the engine RPM and hold at 1500 RPM until NORMAL operating temperature is reached.
4. Raise the engine RPM again and hold at 2500 RPM. Allow the engine to run for approximately 5 minutes in order to heat up the exhaust system.
5. Return the engine to idle speed and shut the engine “OFF.”
6. Refer to “Engine Storage” and “Draining Instruction” to make certain the engine is fully protected from freezing during the remaining storage period.

Following this procedure will reduce the possibility of condensation build up in the engine exhaust system, due to cold weather start-ups.

RECOMMISSIONING AFTER STORAGE

IMPORTANT: This service should be performed by an Authorized Crusader Marine Engines Premier Dealer.

When recommissioning the engine after storage, the following items should be checked:

1. Assemble the raw water pump and reinstall on the engine.
2. Check all the cooling system hoses. Be sure they are properly connected and all the hose clamps are tight.

CAUTION

When installing the battery, make certain that you connect the POSITIVE (+) BATTERY CABLE to the POSITIVE (+) BATTERY TERMINAL first, and the NEGATIVE (-) BATTERY CABLE to the NEGATIVE (-) BATTERY TERMINAL last. If the battery cables are reversed, the electrical system will be damaged.

WARNING

Do not use jumper cables and/or a booster battery to start the engine. Do not recharge a weak battery in the boat. Remove the battery and recharge in a ventilated area away from fuel vapors, sparks or open flame.

3. Install the fully charged battery. Be sure that all the connections are clean and free from corrosion. Coat the battery terminal connections with an anti-corrosion battery terminal spray.
4. Readjust alternator and water pump drive belt tension.
5. Check engine alignment.
6. Check engine and transmission oil levels.
7. Check engine mount fasteners.

RECOMMISSIONING AFTER STORAGE

CAUTION

Failure to remove the excess storage oil from the engine's cylinders can cause hydrostatic locking to occur, and severe damage to the engine.

8. Open the fuel shut-off valve (if equipped).

9. Refer to the OPERATING INSTRUCTIONS section and perform all the safety checks before starting the engine.

10. Refer to the Engine Maintenance section and perform the Priming the Fuel System instructions.

CAUTION

If the engine(s) is (are) to be started prior to launching, use the procedure FLUSHING COOLING SYSTEM before proceeding to start the engine(s).

11. Open the seacock before starting the engine.

12. Start the engine and closely observe the instrument panel. Allow the engine to reach normal operating temperature. Inspect the engine carefully for fuel, exhaust, oil and water leaks.

13. Check the steering, shift and throttle controls for proper operation.

Engine performance complaints usually fall under one of the basic headings listed in the Troubleshooting Guide. When a problem cannot be easily diagnosed, consult a Crusader Marine Engines Premier Dealer for assistance.

Malfunction	Possible Cause	Corrective Action
Engine will not crank with the starter motor, or cranks slowly.	Battery switch turned OFF (if equipped)	Turn the battery switch ON.
	Remote control not in Neutral position.	Position the remote control exactly in Neutral.
	Blown the ignition fuse or open circuit breakers.	Replace the fuse - reset circuit breakers.
	Loose and/or dirty wiring connections.	Check the battery cables and starter circuit wiring. Clean and tighten all connections. Repair or replace the damaged wiring.
	Dead Battery	Recharge, test and replace as necessary.
Engine Cranks - will not start or is hard starting.	Improper starting procedure.	Refer to “STARTING ENGINE” in the OPERATING INSTRUCTIONS section.
	No fuel - empty fuel tank	Check the fuel tank level - fill tank(s). Open shut-off valve(s).
	No fuel to the carburetor	Plugged fuel filters. Plugged or kinked fuel lines or plugged fuel-tank vent. Faulty fuel pump - check electrical connections. Faulty anti-siphon valve.
	Choke operating improperly	Check choke linkage for freedom of movement and proper adjustment.
		Check 12V power lead.
	Engine flooded	Open the throttle 100% and crank the engine. When the engine starts, immediately return the throttle to 1000 RPM.
	Ignition system malfunction	Service ignition system. Check tune-up specifications.
	Contaminated fuel	Check fuel for water or other contamination. If contaminated, drain and clean the fuel system.

Malfunction	Possible Cause	Corrective Action
Engine Overheats	Loose or worn drive belt(s)	Adjust or replace the belts as necessary.
	Collapsed, kinked or leaking hoses.	Replace the hoses.
	Transmission/engine oil cooler plugged	Remove the water hoses and flush in opposite direction of the normal flow.
	Faulty thermostat	Replace the thermostat.
	Sea-water intake valve partially/fully closed.	Open the valve completely.
	Restricted sea-water pickup	Remove restriction.
	Faulty temperature sending unit or gauge	Test and replace as necessary.
	Sea-water pump impeller worn or damaged	Replace the impeller.
The following applies to engines equipped with Fresh-Water Cooling (FWC) systems.	Coolant level low in the fresh-water section of the cooling system	Check the cooling system for leaks. Refill the system. See Warning before removing the fill cap.
	Heat exchanger passages plugged with scales and debris	Clean and flush the exchanger.
	Improper coolant mixture	Install the proper coolant mixture (50% antifreeze - 50% water).
Insufficient engine temperature	Faulty thermostat	Replace the thermostat.
	Faulty temperature sender	Replace the temperature sender.
Engine oil pressure low	Faulty oil pressure sending unit or gauge	Test and replace as necessary.
	Oil level low	Add specified oil. Check the engine for leaks.
	Crankcase overfilled causing oil aeration	Remove the required amount of oil. Determine the cause of overfilled condition (improper filling, etc.).
	Diluted or improper grade/ viscosity of oil	Change the oil and filter. Determine the cause of dilution. (insufficient engine temperature, excessive idling, etc.)

Malfunction	Possible Cause	Corrective Action
Transmission slipping - erratic operation	Low oil level	Add specified oil. Check the transmission for leaks.
	Transmission overfilled causing oil aeration	Drain required amount of oil.
	Transmission shift lever not fully engaged	Adjust the shift linkage and remote control. Check the shift cables for freedom of movement and binding.
	Contaminated fluid	Determine and correct the contamination source and change the fluid.
Engine misses, runs rough	Ignition system malfunction	Service ignition system. Check tune-up specifications.
	Idle speed too low	Adjust idle mixture and/or idle speed.
	Choke operating improperly	Check choke linkage for freedom of movement and choke for proper adjustment.
	Plugged fuel filters	Replace the fuel filters.
	Faulty fuel pump.	Have fuel pump replaced by a Crusader Engines Premier Dealer
	Plugged or kinked fuel lines or fuel tank vent	Repair or replace the fuel lines. Remove obstruction.
	Anti-siphon valve faulty	Clean or replace as necessary.
	Flame arrestor dirty	Clean the flame arrestor..

Malfunction	Possible Cause	Corrective Action
Poor engine or boat performance	Ignition malfunction	Service ignition system. Check tune-up specifications.
	Carburetor malfunction	Service carburetor.
	Throttle not fully open	Check the remote control and carburetor linkage for freedom of movement and proper adjustment.
	Damaged or improper propeller	Repair or replace as necessary.
	Excessive water in the bilge	Pump the water out and investigate source of entry.
	Excessive growth on the boat bottom	Clean the bottom and paint with an anti-fouling paint.
	Boat overloaded	Reduce and/or redistribute the load.
	Dirty flame arrestor	Clean the flame arrestor.
	Engine overheating	Repair the cooling system (See “Engine Overheats”).

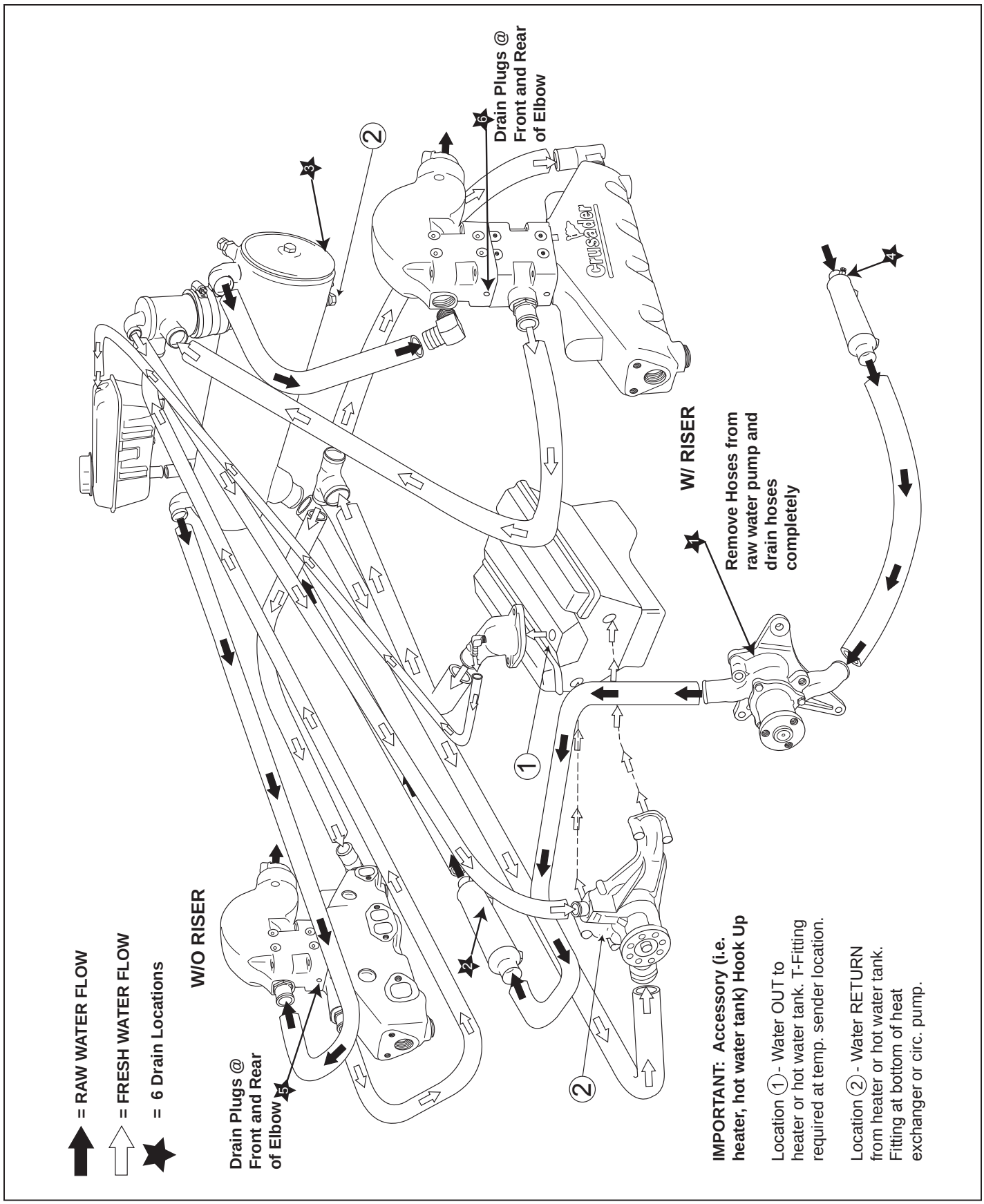
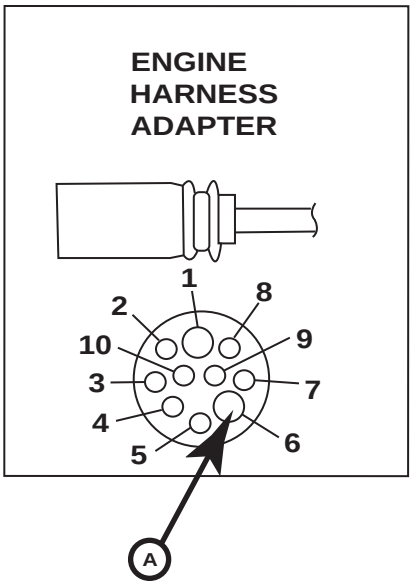

= RAW WATER FLOW
= FRESH WATER FLOW
= 6 Drain Locations
W/O RISER
Drain Plugs @ Front and Rear of Elbow
5
2
2
1
W/ RISER
Remove Hoses from raw water pump and drain hoses completely
4
3
2
Drain Plugs @ Front and Rear of Elbow
6
IMPORTANT: Accessory (i.e. heater, hot water tank) Hook Up
Location ① - Water OUT to heater or hot water tank. T-Fitting required at temp. sender location.
Location ② - Water RETURN from heater or hot water tank. Fitting at bottom of heat exchanger or circ. pump.

Figure 14-1 Fresh-Water Cooling System (5.7L)

ENGINE HARNESS WIRING DIAGRAMS - 15

WIRE HARNESS COLOR CHART

CIRCUIT NUMBER	CIRCUIT NAME	ENGINE HARNESS WIRE COLOR
1.	GROUND	BLACK
2.	TACHOMETER	GRAY
3.	WATER TEMPERATURE	TAN
4.		N/C
5.	IGNITION	PURPLE
6.	BATTERY	RED
7.	STARTER	YELLOW/RED
8.	OIL PRESSURE	LT. BLUE
9.		N/C
10.		N/C



NOTE: ENGINE HARNESS WIRED FOR PANELS USING VOLTMETERS ONLY.

NOTE (A): POWER FOR A FUSED ACCESSORY PANEL MAY BE TAKEN FROM THIS LOCATION. LOAD CANNOT EXCEED 30 AMPS.

IMPORTANT: Your engine is designed to work with the standard electronics installed in your boat. If you add other electrical components or accessories, you could change the way the fuel injection controls your engine or the overall electrical system functions. Before adding electrical equipment, consult your dealer. If you don't, your engine may not perform properly.

CAUTION

Add-on equipment may adversely affect the alternator output or overload the electrical system. Any damage caused as a result will not be covered by, and may void, your warranty.

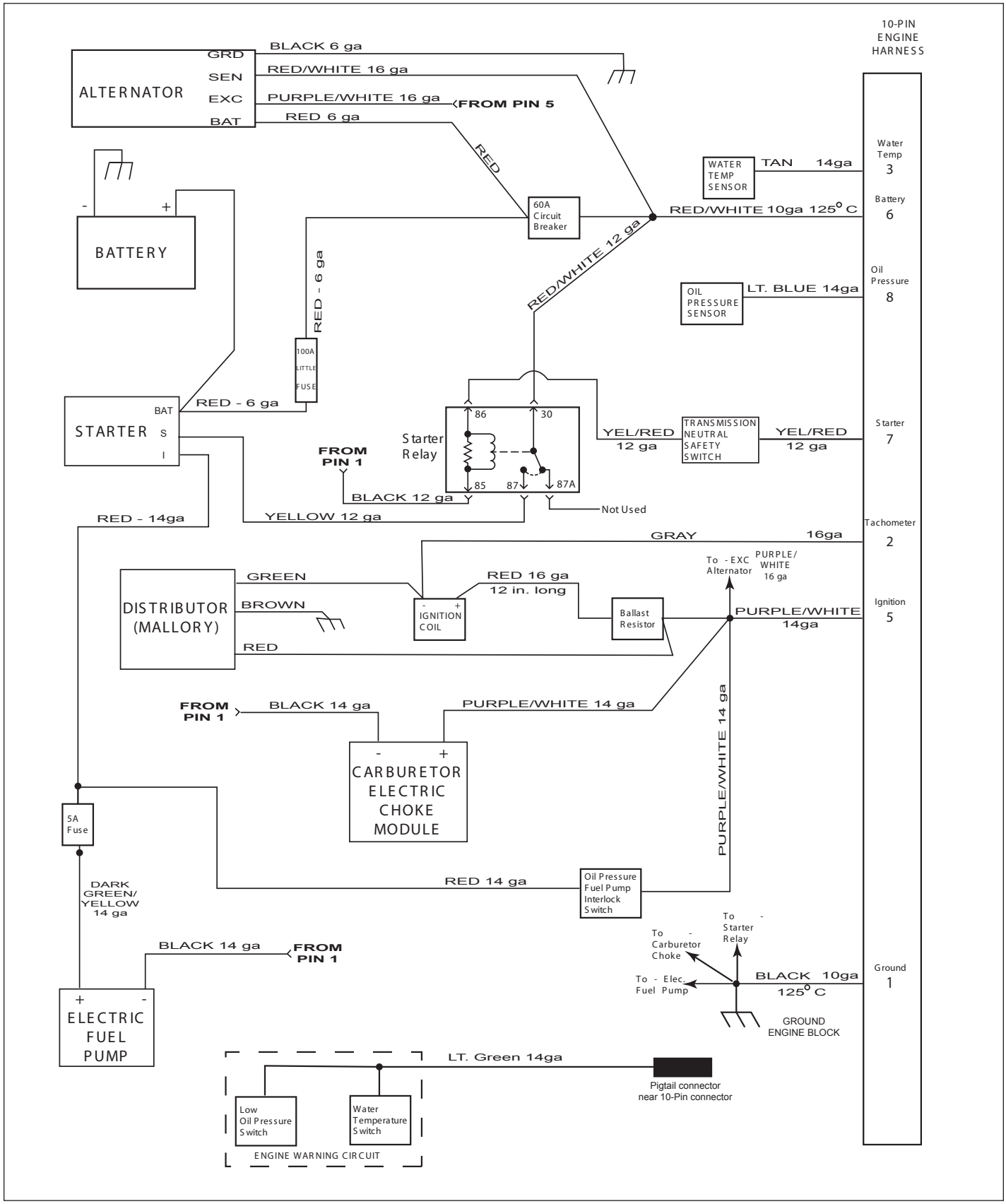


Figure 15-3 Typical Engine Wiring w/Mallory Ignition

LITERATURE - 16

To obtain service and/or parts literature for your Crusader Marine Engines, contact the following:

Crusader Marine Engines
Publications Department
P.O. Drawer 369
Little Mountain, SC 29075

IMPORTANT: When contacting the factory for service information, be sure to include your engine model and serial number to insure the service information you receive is correct.

SUMMARY OF WARRANTY TERM LIMITS

This list does not, in any way, modify the official Limited Warranty Statement of Crusader Engines. This list has been compiled only as a general outline of year and hour limits imposed on different models of Crusader engines. Please review the official Limited Warranty Statements for specific terms and limitations as they apply to the particular engine / component involved.

ENGINE MODEL YEAR:	WARRANTY COVERAGE TERM:
2006	2 year, unlimited hours, GM engine. 2 year, unlimited hours, Transmission.
2007	2 year, unlimited hours, GM engine. 2 year, unlimited hours, Transmission.
2008	2 year, unlimited hours, GM engine. 2 year, unlimited hours, Transmission.
2009	2 year, unlimited hours, GM engine. 2 year, unlimited hours, Transmission.
Base Engine	1 year, 200 hours with exclusions.

Note:

** Captains Choice Series has additional 2 years extended warranty administered by First Protection Corporation.

CRUSADER OWNERSHIP CHANGE NOTICE

If you are the new owner of a Crusader Marine Engine on which the warranty has expired and would like to inform Crusader of your ownership for notification purposes in case of Service Updates, Recalls, etc., complete the section below and return by mail to Crusader Marine Engines, PO Drawer 369, Little Mountain, SC 29075.

	PORT	STARBOARD
ENGINE MODEL:		
ENGINE SERIAL NUMBER:		
TRANS. MODEL:		
TRANS. SERIAL NUMBER:		
HULL SERIAL #:		

(New Owner) NAME: _____

ADDRESS: _____

CITY,STATE,ZIP: _____

DATE OF PURCHASE: _____

(Previous Owner)NAME: _____

ADDRESS: _____

CITY,STATE,ZIP: _____

CRUSADER WARRANTY TRANSFER APPLICATION

(PORT OR SINGLE ENGINE)

The remainder of the original Crusader limited warranty is transferable **within thirty (30) days of date of sale** by the original owner/user to a subsequent purchaser for the remainder of the unused portion of the original warranty term, **provided the engine(s) operating hours do not exceed 300.** The original date of sale or original in-service date (whichever comes first) begins the warranty coverage period.

Direct Sale by Owner/Dealer or First Operator:

- The second purchaser can be registered as the owner and retain the unused portion of the warranty term by sending the following:
  - Original owner's Warranty Registration Card
  - Copy of Bill of Sale/Sales Contract/Operator Contract
  - Completed Warranty Transfer Application
  - Warranty transfer fee

Transfer Fee:

- **The fee for transfer is $50.00 per engine.** The applicable transfer fee must be submitted via certified check **within 30 days of date of sale** along with the transfer application information to:

  Crusader Marine Engines
  Marine Warranty Transfer
  P.O. Drawer 369
  Little Mountain, S.C., 29075, USA

- A new "Owner Warranty Registration Card" will be issued with the new owner's name and address. Registration records will be changed in the factory registration file.

OUTSIDE THE U.S. AND CANADA, CONTACT YOUR LOCAL CRUSADER DEALER OR WARRANTY SERVICES AT (803)345-0050 FOR MORE INFORMATION ON HOW TO APPLY TO THIS PROGRAM.

IMPORTANT! PURCHASER NOTICE: The checks listed below are designed to insure safety and satisfaction. Premier Crusader Dealer Technicians have received step-by-step instruction in the performance of the Pre-Delivery Inspection. Therefore, we require the following inspection be performed at your expense by a qualified technician prior to delivery. By signature the technician certifies that he/she has checked the installation and operation of the engine and finds it to be performing properly. All terms in the Limited Warranty located in the Engine Owners Manual still apply.

ENGINE MODEL:_____ **ENGINE SERIAL:**_____

TRANS. SERIAL:_____ **ENGINE HOURS:**_____

HULL SERIAL #:_____

Pre-Delivery Checklist - PORT or Single

- ☐ Check for Bulletins
- ☐ Engine Oil: Check
- ☐ Drive Lube: Check
- ☐ Battery Rating, Charge, and Level: Check
- ☐ Control Adjustments: Confirm Proper Operation
- ☐ Gauges: Check for Proper Operation
- ☐ Record Propeller Size, Rotation and WOT
  WOT RPM_____Diameter_____ Pitch_____Rotation_____
- ☐ Record Fuel Pressure, WOT _____
- ☐ Dealer Reviewed Warranty with Owner
- ☐ Belt and Pulley: Inspect for Damage
- ☐ All Drain Plugs: Confirm Proper Installation
- ☐ All Fuel Lines: Confirm No Leaks
- ☐ All Oil Lines: Confirm No Leaks
- ☐ All Water Lines: Confirm No Leaks
- ☐ Electrical Wiring: Check for Proper Installation
- ☐ Trouble Codes Checked
  Trouble Codes Cleared

Type Information To Prevent Processing Delay

DATE OF SALE (2ND Owner) _____/_____/_____ **DATE OF SALE (1st Owner/1st Operator)** _____/_____/_____

(New Owner)
NAME:_____

ADDRESS:_____

CITY,STATE, ZIP_____

(Previous Owner)
NAME:_____

ADDRESS:_____

CITY,STATE, ZIP_____

I hereby certify the Pre-Delivery Checklist on engine #_____ and have corrected any abnormality revealed by this inspection.

_____ _____ _____
(Technician Signature, Dealer & Date) **(Seller's Signature & Date)** **(Purchaser's Signature & Date)**

CRUSADER WARRANTY TRANSFER APPLICATION (STARBOARD ENGINE)

The remainder of the original Crusader limited warranty is transferable **within thirty (30) days of date of sale** by the original owner/user to a subsequent purchaser for the remainder of the unused portion of the original warranty term, **provided the engine(s) operating hours do not exceed 300.** The original date of sale or original in-service date (whichever comes first) begins the warranty coverage period.

Direct Sale by Owner/Dealer or First Operator:

- The second purchaser can be registered as the owner and retain the unused portion of the warranty term by sending the following:
  - Original owner's Warranty Registration Card
  - Copy of Bill of Sale/Sales Contract/Operator Contract
  - Completed Warranty Transfer Application
  - Warranty transfer fee

Transfer Fee:

- **The fee for transfer is $50.00 per engine.** The applicable transfer fee must be submitted via certified check **within 30 days of date of sale** along with the transfer application information to:

  Crusader Marine Engines
  Marine Warranty Transfer
  P.O. Drawer 369
  Little Mountain, S.C., 29075, USA

- A new "Owner Warranty Registration Card" will be issued with the new owner's name and address. Registration records will be changed in the factory registration file.

OUTSIDE THE U.S. AND CANADA, CONTACT YOUR LOCAL CRUSADER DEALER OR WARRANTY SERVICES AT (803)345-0050 FOR MORE INFORMATION ON HOW TO APPLY TO THIS PROGRAM.

IMPORTANT! PURCHASER NOTICE: The checks listed below are designed to insure safety and satisfaction. Premier Crusader Dealer Technicians have received step-by-step instruction in the performance of the Pre-Delivery Inspection. Therefore, we require the following inspection be performed at your expense by a qualified technician prior to delivery. By signature the technician certifies that he/she has checked the installation and operation of the engine and finds it to be performing properly. All terms in the Limited Warranty located in the Engine Owners Manual still apply.

ENGINE MODEL:_____ **ENGINE SERIAL:**_____

TRANS. SERIAL:_____ **ENGINE HOURS:**_____

HULL SERIAL #:_____

Pre-Delivery Checklist - STARBOARD

- ☐ Check for Bulletins
- ☐ Belt and Pulley: Inspect for Damage
- ☐ Engine Oil: Check
- ☐ All Drain Plugs: Confirm Proper Installation
- ☐ Drive Lube: Check
- ☐ All Fuel Lines: Confirm No Leaks
- ☐ Battery Rating, Charge, and Level: Check
- ☐ All Oil Lines: Confirm No Leaks
- ☐ Control Adjustments: Confirm Proper Operation
- ☐ All Water Lines: Confirm No Leaks
- ☐ Gauges: Check for Proper Operation
- ☐ Electrical Wiring: Check for Proper Installation
- ☐ Record Propeller Size, Rotation and WOT
  WOT RPM_____Diameter_____ Pitch_____Rotation_____
- ☐ Record Fuel Pressure, WOT _____
- ☐ Trouble Codes Checked
  Trouble Codes Cleared
- ☐ Dealer Reviewed Warranty with Owner

Type Information To Prevent Processing Delay

DATE OF SALE (2ND Owner) _____/_____/_____ **DATE OF SALE (1st Owner/1st Operator)** _____/_____/_____

(New Owner)
NAME:_____

ADDRESS:_____

CITY,STATE, ZIP_____

(Previous Owner)
NAME:_____

ADDRESS:_____

CITY,STATE, ZIP_____

I hereby certify the Pre-Delivery Checklist on engine #_____ and have corrected any abnormality revealed by this inspection.

_____ **(Technician Signature, Dealer & Date)**

_____ **(Seller's Signature & Date)**

_____ **(Purchaser's Signature & Date)**

Crusader ENGINES

CRUSADER, INC. INBOARD MARINE ENGINES
TWO (2) YEAR LIMITED WARRANTY
(For Engines Sold and Used in the United States and Canada Only)

1. Crusader, Inc. (hereinafter referred to as "Crusader") warrants each of its new inboard marine engines and accessories attached thereto ("Products"), to be free from defects in material and workmanship for a period of two (2) years, except to the extent limited herein. This Limited Warranty commences on the day of the first retail sale and/or the first date used, and extends to the original and subsequent retail sales; however, in no event shall the duration of the Limited Warranty exceed two (2) years, as measured from the original retail sale date.

2. Under this Limited Warranty, Crusader's obligation is limited to repairing or replacing those parts of Products that have become defective within the applicable warranty period, because of defective materials or workmanship. Crusader will arrange for the correction of all defects under this Limited Warranty to be made free of charge at the selling dealership or an authorized Crusader service center. Crusader, in its discretion, may provide for the repair or replacement of any defective part at Crusader's facility. Crusader will make payment for labor to replace such parts as provided in the, then, current flat rate labor manual or Warranty Procedures Manual.

3. This Limited Warranty does not apply to Product defects caused by normal wear and tear to Products, and/or damage to Products arising out of negligence or lack of proper care, improper installation or service, operation with fuels, oils or lubricants which are not suitable for use with Products, alterations or removal of parts, water entering an engine through the exhaust system or carburetor, installation of accessories or parts not manufactured or sold by Crusader, or Products rendered defective by accident.

4. If a part should become defective within the applicable warranty period, advance authorization by Crusader is necessary before the part is replaced or a defect is corrected by a service representative; otherwise Crusader will not be liable for the expense of the replacement or correction.

5. Replacement parts and accessories supplied by Crusader, and installed on a Product during the period when the Product is covered under the provisions of this Limited Warranty, are warranted for the unexpired portion of the existing warranty period, or ninety (90) days from the date of installation of such new parts or accessories, whichever is longer.

6. Reasonable access to the Product must be provided for warranty service. This Limited Warranty does not cover: (1) telephone or telegram charges, towing charges, storage, launch and haul out charges, loss or damage to personal property, loss of revenue, loss of time, travel, lodging, inconveniences or other CONSEQUENTIAL DAMAGES, or (2) removal and/or replacement of boat partitions or material, because of boat design, for necessary access to the Product.

7. NO OTHER WARRANTY GIVEN. THE OBLIGATIONS SET FORTH IN THE PRECEDING PARAGRAPHS ARE CRUSADER'S SOLE OBLIGATIONS AND OWNER/USER'S EXCLUSIVE REMEDY. CRUSADER MAKES NO OTHER WARRANTY, EXPRESS OR IMPLIED (except to the extent provided in the immediately following paragraph), AND MAKES NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR PARTICULAR PURPOSE.

However, to the extent that any warranty may be implied by law, the term of such implied warranty shall be limited to a period of time corresponding to the period of express warranty applicable to the particular Product, and its use by the owner/user, as set forth herein, commencing on the date of the first retail sale of the Product to the first registered owner or registered user. Some states do not allow limitations on how long an implied warranty lasts, so the above limitation may not apply to you. This is sole warranty provided respecting Crusader's Products, and no other party may make a warranty to owner/user.

CRUSADER SHALL NOT BE LIABLE FOR ANY LOSS OF TIME, INCONVENIENCE, COMMERCIAL LOSS OR DIRECT OR INDIRECT, INCIDENTAL (except as specifically provided herein) OR CONSEQUENTIAL DAMAGES. Some state do not allow the exclusion or limitation of incidental or consequential damages, so this limitation or exclusion may not apply to you. This Warranty gives you specific legal rights, and you may also have other rights which vary from state to state.

Any owner/user hereby waives for himself/herself/itself and his/her/its successors and assigns (a) any and all claims for punitive damages, and (b) all claims of negligence or strict liability or both. In no event will Crusader's liability exceed the purchase price of the Products which is actually paid to Crusader.

8. To make a claim under this Limited Warranty, contact the selling dealer from which your Crusader powered boat was originally purchased or the nearest authorized Crusader servicing dealer. It is recommended that your warranty service be performed by the dealer which sold the Product to you because of that dealer's personal interest in you as a customer. Your Crusader powered Product must be delivered to the servicing dealer within the applicable warranty period. Proof of purchase may be required by the Crusader dealer to substantiate any warranty claim. Use your Crusader Owner Warranty Registration Card to establish proof of purchase.

9. ITEMS NOT COVERED UNDER LIMITED WARRANTY

This Limited Warranty is limited to defects in material and workmanship. To avoid misunderstandings regarding warranty coverage, the following describes some, but not all, of the more common types of service that are not covered by this Limited Warranty.

- Normal service requirements arising during the warranty period, such as fuel system or ignition adjustments, tune-ups, filter, adjusting controls or lubrications.
- Damage caused by neglect, lack of maintenance, abnormal operation accident or improper installation or service.
- Normal wear of the piston rings, cylinders, water pump and other engine parts.
- Haul out, launching, towing charges, dockage or storage fees, removal and/or replacement of boat partitions or material, because of boat design, for necessary access to the product.
- All related transportation charges and/or travel time.
- The cost of shipping replacement parts by air freight or other premium freight methods
- Improper winterizing resulting in freezing and breaking of the engine block, cylinder heads, exhaust manifolds, heat exchanger or other damage.
- Repairs made necessary by normal wear, rust, electrolysis or corrosion, or by the use of the parts or accessories which are either incompatible with the Crusader product or adversely affect its operation, performance or durability.
- Valve or valve seat grinding required because of wear.
- Failure or damage due to lack of cooling water caused by starting the Product out of the water or by foreign material blocking the water inlets.
- Cleaning of the engine fuel system due to water or dirt contamination of the boat fuel system.
- Use of fuel and lubricants which are not suitable for use with or on the Product. Refer to the Operation and Maintenance Manual.
- Damage to the engine and/or transmission caused by striking a submerged object. (This is considered a marine hazard).

10. This Limited Warranty shall be governed by, and construed and interpreted in accordance with, the laws of the State of Ohio, without application of its conflicts of laws principles, except only to the extent replaced or precluded by other law of mandatory application.

11. SPECIAL STATE LEGAL REQUIREMENTS. This Warranty gives you specific legal rights, and you may also have other rights which vary from State to State. The Crusader California Emissions Warranty and California Emission Control Warranty Statement is a separate document included in this Manual. Any questions concerning the Emissions Warranty can be obtained by calling 1-586-977-0100.

L585003

Information below must be completely filled in to activate Warranty/Registration.

WARRANTY REGISTRATION CARD

IMPORTANT: The checks as listed below are required to insure the safety and satisfaction of you, the owner. By signing this form, the dealer certifies that he has checked the installation and operation of the engine(s) and finds them to be performing properly. The owner or his agent should perform similar inspections periodically to identify potential problems before they occur and have any suspected defects checked and/or corrected immediately.

Make Owner and Dealer copies of the Registration Card, as required. Mail <u>original</u> to Crusader Marine Engines.

(Please Type Information to Prevent a Processing Delay.)

Use Owner's Copy for Warranty ID until Warranty Identification Card is received by Owner.

Port - Engine Model # | Engine Serial #. | Transmission Model # | Transmission Serial #

Stbd - Engine Model # | Engine Serial #. | Transmission Model # | Transmission Serial #

Owner's Name

Address | City, State | Zip

Date of Sale | **Dealer Signature**

Selling Dealer | **PREMIER DEALER #**

Address | City, State | Zip

Pre-Delivery Checklist

- ☐ Check for Bulletins
- ☐ Engine Oil: Check
- ☐ Drive Lube: Check
- ☐ Battery Rating, Charge, and Level: Check
- ☐ Control Adjustments: Confirm Proper Operation
- ☐ Gauges: Check for Proper Operation
- ☐ Belt and Pulley: Inspect for Damage
- ☐ All Drain Plugs: Confirm Proper Installation
- ☐ All Fuel Lines: Confirm No Leaks
- ☐ All Oil Lines: Confirm No Leaks
- ☐ All Water Lines: Confirm No Leaks
- ☐ Electrical Wiring: Check for Proper Installation
- ☐ Record Propeller Size, Rotation and WOT - **Port**
  WOT RPM_____Diameter_____ Pitch_____Rotation_____
- ☐ Record Propeller Size, Rotation and WOT - **Stbd**
  WOT RPM_____Diameter_____ Pitch_____Rotation_____
- ☐ **Port** - Record Fuel Pressure, WOT _____
- ☐ **Starboard** - Record Fuel Pressure, WOT _____
- ☐ Dealer Reviewed Warranty with Owner
- ☐ Trouble Codes Checked Trouble Codes Cleared

Owner's Signature | Date

Boat Make | **Hull Serial #** | **Length**

Crusader Marine Engines PO Drawer 369 Little Mountain, SC 29075

From:_____

_____

_____

FIRST
CLASS
POSTAGE

MAIL TO:

WARRANTY DEPARTMENT
CRUSADER MARINE ENGINES
P.O. DRAWER 369
LITTLE MOUNTAIN, SC 29075

This Page

Was Intentionally

Left Blank